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2

DEPARTMENT OF THE AIR FORCE

SUPPORTING DATA FOR FISCAL YEAR 1988/89 BUDGET ESTIMATES

SUBMITTED TO CONGRESS JANUARY 1987

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DESCRIPTIVE SUMMARIES

RESEARCH, DEVELOPMENT, TEST AND EVALUATION

DISCLAIMER NOTICE

DESCRIPTIVE SUMMARIES FOR PROGRAM ELEMENTS OF THE DEPARTMENT OF THE AIR FORCE RESEARCH AND DEVELOPMENT PROGRAM
FY 1988/89
JANUARY 1987

INTRODUCTION AND EXPLANATION OF CONTENTS

1. (U) General. This document has been prepared to provide information on the United States Air Force (USAF) Research, Development, Test and Evaluation (RDT&E) Program to Congressional Committees during the Fiscal Year 1988/89 hearings. This information is in addition to the testimony given by DOD witnesses.

(U) The Descriptive Summaries provide narrative information on all RDT&E program elements and projects, except those listed in para 4b, within the USAF FY 1988/89 RDT&E Program. A Test and Evaluation section is provided for major weapon systems. The formats and contents of this document are in accordance with the guidelines and requirements of the Congressional Committees insofar as possible.

(U) The "RESOURCES" portion of the Descriptive Summaries includes, in addition to RDT&E funds, procurement funds and quantities, Military Construction Appropriation funds on specific development programs, Operation and Maintenance Appropriation funds where they are essential to the development effort described, and, where appropriate, Department of Energy (DOE) costs.

(U) Pages 1080-1088 are in response to the Senate Appropriations Committee requirement contained on page 78 of the Senate Appropriations Committee report (98-292, 1 November 1983).

(U) The section of the Fiscal Year 1988/89 Descriptive Summaries entitled "Facilities Exhibits" (pages 1094-1143) contains information on major improvements to and construction of government owned facilities funded by RDT&E.

2. (U) Comparison of Fiscal Year 1986 and 1987 Data. A direct comparison of Fiscal Year 1986 and Fiscal Year 1987 data shown in this document with corresponding data in the Program Element Descriptive Summaries dated February 1986 will reveal significant differences. Many of the differences are attributable to the following factors:

a. (U) Fiscal Year 1987 reductions as a result of Congressional action on the appropriation.

b. (U) Fiscal Year 1986 funding changes between 1 October 1985 and 30 September 1986 due to RDT&E Reprogramming Actions.

e. (U) Reclassification of Fiscal Year 1986 and Fiscal Year 1987 data to achieve comparability with the program structure for Fiscal Year 1988/89.

3. (U) <u>Relationship of Fiscal Year 1988/89 Budget Structure to the Fiscal Year 1987 Budget Approved by the Congress.</u>

<u>PROGRAM ELEMENT</u>	<u>REMARKS</u>
<u>BUDGET ACTIVITY 1: TECHNOLOGY BASE</u>	
None	
<u>BUDGET ACTIVITY 2: ADVANCED TECHNOLOGY DEVELOPMENT</u>	
None	
<u>BUDGET ACTIVITY 3: STRATEGIC PROGRAMS</u>	
63738F Air Defense Initiative Surveillance Technology	New program element for efforts previously contained in Program Elements 63424F and 63716F
64216F Worldwide Airborne Command Post System Replacement	New program element for effort previously contained in Program Element 11312F
<u>BUDGET ACTIVITY 4: TACTICAL PROGRAMS</u>	
27316F Tacit Rainbow	New program element for effort previously contained in classified program element
64248F Modular Standoff Weapons	New program element for effort previously contained in Program Element 63790F
64704F Common Support Equipment Development	New program element for effort previously contained in Program Element 64708F
64754F Joint Tactical Information Distribution System	Continuing program for effort contained in OSD Program Element 64711D

2 (2)

BUDGET ACTIVITY 5: INTELLIGENCE & COMMUNICATIONS

None

BUDGET ACTIVITY 6: DEFENSE-WIDE MISSION SUPPORT

65809F Dynamic Coherent Measurement System — New program proposed for FY 1988

h.

TABLE OF CONTENTS
BUDGET ACTIVITY, PROGRAM ELEMENT SEQUENCE

Note: Table of Contents in Program Element sequence starts on page xvi.

@ 9

ELEMENT CODE	TITLE	PAGE
TACTICAL PROGRAMS (Cont.)		

(12) 11

ELEMENT CODE	TITLE	PAGE
DEFENSE-WIDE MISSION SUPPORT (Cont.)		

TABLE OF CONTENTS
PROGRAM ELEMENT SEQUENCE

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 61101F
DOD Mission Area: 510 - Defense Research

Title: In-House Laboratory Independent Research
Budget Activity: 1 - Technology Base

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		14,830	15,125	15,653	16,733	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Science and Technology program provides discretionary funds to Air Force Laboratory Directors to use in pursuing promising high technical risk, high potential payoff opportunities which arise during the budget year. This program allows the Air Force Laboratories to maintain an aggressive research program critical to their existence and role as leaders of national research. This program is especially important in light of the increasing challenge to maintain technogical superiority over potential adversaries. The Deputy for Advanced Technology in the Office of the Assistant Secretary of the Air Force (Research, Development, and Logistics) determines the distribution of funds to the thirteen participating Laboratories based on reviews of the previous year's efforts.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	16,000	17,465	19,741	N/A	Continuing	N/A

EXPLANATION: (U) The FY 1986 and FY 1987 differences are due to Congressional reductions of funds. The FY 1988 difference is part of an overall Air Force RDT&E budget reduction.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: Investigations funded by this program are an important and an integral part of the total Science and Technology programs of the Air Force Laboratories. Results from this Program Element are transitioned to the other research and development activities of the Laboratories for continued funding. The Army and Navy have similar programs. Oversight responsibility for these programs is in the Office of the Deputy Under Secretary of Defense (Research and Advanced Technology).

6. (U) WORK PERFORMED BY: Numerous small contracts are placed with universities and industrial laboratories each year, in addition to work units performed within the Air Force Laboratories. The five major contractors during FY 1986 were: Laser Science Inc., Cambridge, MA (Ten-Micrometer Laser); United Technology Corp. subsidiaries, United Space Boosters, Inc., Huntsville, AL (Solid Rocket Motor Design for Automated Manufacturing), Pratt and Whitney Aircraft, Inc., West Palm Beach, FL. (Rapidly Solidified Light Weight Durable Disk Material, and Rolling Contact Fatigue Mechanisms); Los Alamos National Laboratory, Los Alamos, NM (High Explosive Driven Kill Mechanism); Technology Services Corporation, Santa Monica, CA (Low Cost Multi-Sensor Image Generator); and Allied Corp, Mount Bethel, NJ

(Selectively Tunable Optical Sources). There were 119 additional contractors doing work under 171 contracts at a total dollar value of $12.7 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 61101F, In-House Laboratory Independent Research

A. (U) Project Description: The purpose of this program is to provide discretionary authority to Laboratory Directors of the Air Force Systems Command to fund technology efforts judged to be of high promise or importance. The Air Force has set up and administered this program in strict compliance with the intent that it would be unencumbered by restrictive reviews and procedures, or justification and documentation prior to beginning work. Laboratory Directors meet annually with the Assistant Secretary of the Air Force for Research, Development, and Logistics to report achievements and the status of their projects.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: The following is a sampling of noteworthy efforts. They were selected to demonstrate the scope of the program.

a. (U) Low Cost Multi-Sensor Image Generator. This effort represents an opportunity to demonstrate the capability of providing a visual Forward Looking Infrared Radar and Synthetic Aperture Radar image at low cost. Utilizing current off-the-shelf technology in Computer Image Generator systems, this system provides a low risk approach to real time multi-sensor imagery. Possible payoffs include a cheap, low complexity system for use in Combat Missile Trainer and the Fiber Optic Helmet Mounted Display programs.

b. (U) Silicide Infrared (IR). The objective of this study is to provide the necessary information to qualify the existing platinum silicide IR camera for use on shuttle-based and rocketborne instrument platforms. Specifically, the study considered the optical, electronic, mechanical and cryogenic aspects of qualifying silicide IR cameras for use in space. Continuation of the study will define any special requirements related to installing and operating the cameras on space-based platforms including qualification testing and documentation. The advantage of a Silicide IR camera in space will be high resolution low orbital (IR) imagery with very high sensitivity and the ability to operate through clutter. This represents a considerable increase in the current capability.

c. (U) Adaptive Flight Control Activated Anti-Gravity Valve. The purpose of this effort is to improve protection for the fighter pilot against gravity-induced loss of consciousness. The flight control activated anti-gravity valve is intended to defeat the high onset rate of acceleration of the F-16 and other advanced fighter aircraft. This research is directed at derivation of an algorithm which uses measured avionics parameters, pilot commands, physiological principles, and predicted flight control/fire control commands to inflate an anti-gravity suit

on a rate and magnitude schedule for optimal pilot protection. The prototype valve has been built and its function verified. Testing to date has demonstrated that this anti-gravity valve will significantly decrease loss of pilot consciousness in fighter aircraft, thereby avoiding subsequent loss of the pilot and the aircraft.

d. (U) Biomaterials for Carbon-Carbon Matrices. The Air Force Office of Scientific Research (AFOSR) and the Air Force Materials Laboratory began a jointly supported program to explore the feasibility of using highly conjugated acetylene molecules found in various plant species as novel matrix materials for carbon-carbon composites. These molecules have theoretical char yields greater than 95%, and represent novel chemistry with the potential to afford carbon-carbon composites with enhanced thermal and mechanical properties versus state-of-the-art. The molecules will be synthesized and tailored for processability. Their carbonization will be optimized and the carbonized materials will be evaluated. This program is planned for continuation in FY 1987/FY 1988 by AFOSR. If the materials continue to show promise, a follow-on program will address low cost biosynthesis.

e. (U) Application of Expert Artificial Intelligence (Knowledge Base) System to Corrosion. This effort involved development work on a knowledge based expert system in aircraft corrosion and the delivery of software capable of being installed on an IBM-PC-AT. The work built upon an existing base already developed by the contractor for the chemical process industry and provides support to the Air Force fundamental goal of improving the selection of materials and processes for aircraft manufacturing and maintenance operation.

f. (U) Innovative High Lift Wing Research. The lift on a wing is proportional to the circulation in the flowfield around the wing. Very high lift could be realized even at very high angle of attack if the vorticity, created by the wing's surface, could be trapped near the wing. This high lift would be useful for fighter maneuver. The contractor will attempt to demonstrate this effect via tests in a water tunnel and low speed wind tunnel and by computational methods.

g. (U) Endothermic Fuel. This effort reviewed prior work evaluating endothermic (heat absorbing) fuels which relieve the heat build-up problems of vehicles in hypersonic flight. Endothermic fuels are readily available and are more easily handled than cryogenic fuels. The results from this program have been applied to several ongoing exploratory development high mach propulsion programs and resulted in several new programs being initiated. These new programs are implementing recommendations stressing the need to investigate catalyst stability for extended operating times, effect of multi-phase flow, methods of preventing coke formation, and system engineering design analysis.

h. (U) Composite Ceramic Component Propulsion Opportunities. Significant improvements in gas turbine operating efficiencies can be obtained through the uncooled operation of turbine blades and vanes at temperatures above those attainable with high temperature metals and superalloys. Current and projected capabilities of composite ceramic materials and their applicability to turbine engine components have been assessed. Preliminary designs of a turbine blade and vane have been completed. The designs are based on ceramic/ceramic and glass/ceramic materials. Detailed designs will be completed in FY 1987 following additional characterization of these materials. Successful completion of this program will lead to the testing of ceramic composite turbine engine components in a technology demonstrator engine.

i. Hideawey Fan Evaluation. An effort to evaluate the feasibility of a hideaway fan for advanced turbo-ramjet propulsion systems was begun. This fan would be used in the turbine engine mode of operation and removed from the air stream during ramjet operetion. Removel of the fan during ramjet operation will increase the flow area by 30% and ultimately lead to a 20% reduction in propulsion system weight. The design criteria for the fan will be established and verious design concepts will be evaluated. The selected fan design will be fabricated and evaluated in a workable demonstrator model.

(2) (U) FY 1987 Program: The distribution of $15.2 million for FY 1987 was approved by the Assistant Secretary of the Air Force for Research, Development, and Logistics. Efforts begun in FY 1986 will be continued; the Laboratory Directors will selct new efforts of high promise to be supported during the remainder of 1987.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The program in FY 1988 will continue as in FY 1987. Projects will not be selected until FY 1988.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Continuing. No change from FY 1988 program.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 61102F
DOD Mission Area: 510 - Defense Research

Title: Defense Research Sciences
Budget Activity: 1 - Technology Base

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		189,570	199,626	191,762	204,196	Continuing	N/A
2301	Physics	19,068	19,819	20,820	22,170	Continuing	N/A
2302	Structures	12,858	12,051	11,741	12,502	Continuing	N/A
2303	Chemistry	20,196	22,902	24,996	26,618	Continuing	N/A
2304	Mathematics	19,933	21,386	20,942	22,300	Continuing	N/A
2305	Electronics	20,476	21,919	21,089	22,455	Continuing	N/A
2306	Materials	22,243	23,342	26,249	27,950	Continuing	N/A
2307	Fluid Mechanics	14,709	15,175	14,648	15,598	Continuing	N/A
2308	Energy Conversion	10,437	12,032	11,507	12,253	Continuing	N/A
2309	Terrestrial Sciences	2,719	2,108	1,959	2,086	Continuing	N/A
2310	Atmospheric Sciences	12,554	12,443	11,354	12,091	Continuing	N/A
2311	Astronomy & Astrophysics	7,617	8,110	7,242	7,712	Continuing	N/A
2312	Biological & Medical Sciences	9,271	9,886	10,576	11,262	Continuing	N/A
2313	Human Resources	7,489	8,453	8,639	9,199	Continuing	N/A
2917	University Research Instrumentation	10,000	10,000	0	0	0	50,568

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Science and Technology Base program element exclusively supports Air Force research efforts, comprised of in-house investigations in Air Force Laboratories and extramural activities in academia and industry. The program element funds broad-based scientific and engineering basic research dedicated to stimulating new ideas in areas pertinent to the Air Force mission: aerospace structures and aerodynamics, materials, propulsion and power, electronics, computer science, directed energy and conventional weapons, life sciences, and terrestrial, atmospheric, and space sciences. The efforts contained in this program do not duplicate tasks conducted under the Strategic Defense Initiative. Special areas of emphasis in FY 1988 and FY 1989 are: Neural Architectures and Processing; Nonlinear Optics; Antimatter Physics; Nonlinear Science; Biotechnology for Aerospace Materials; Hypersonic Flight; High Energy Density Propellant; Solid Lubrication; Pavements; Hybrid Materials; and Cognitive Sciences. The effort also enhances the Air Force research capability by improving the technological base in those areas crucial to the Air Force. Examples are support of a summer faculty and graduate student program wherein university researchers spend ten weeks during the summer working at an Air Force laboratory;

a resident research associateship and university resident research program wherein researchers can spend up to a year at an Air Force laboratory; and several graduate assistantships and laboratory graduate fellowship programs in technology areas of critical interest to the Air Force.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
RDT&E	189,570	212,587	213,860	N/A	Continuing	N/A

EXPLANATION: (U) FY 1987 differences are due to Congressional reduction. The FY 1988 reduction accommodates reductions in Air Force Total Obligation Authority.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: Program coordination among government agencies is achieved through annual interagency meetings and data exchange with the Army, Navy, National Science Foundation, Department of Energy, National Aeronautics and Space Administration (NASA), Federal Aviation Administration, Defense Advanced Research Projects Agency, Defense Nuclear Agency, and other Federal research activities. Other means of coordination include annual briefings to the Under Secretary of Defense for Research and Engineering, attendance at technical symposia and topical reviews covering research areas of common interest. Examples of coordinating and joint activities are: A joint program in hypersonic aerodynamics is conducted in conjunction with the Navy and NASA; cloud physics is being jointly funded with the Navy and the Army using a jointly funded facility; a Joint Services Electronics Program supports relevant research at Universities to solve military electronics problems; an Interagency Working Group on Neuroscience coordinates efforts among federal agencies; mathematical sciences are coordinated through the Interagency Committee for Extramural Mathematics Programs. In addition, particularly effective coordination is accomplished on an informal basis among individual Air Force program managers and their counterparts in other agencies.

6. (U) WORK PERFORMED BY: The Air Force basic research program is conducted in Air Force laboratories and under extramural grants and contracts with academic institutions and industry. The entire program is managed by the Air Force Office of Scientific Research, Bolling AFB, DC. Research now underway includes in-house efforts at the Air Force Wright Aeronautical Laboratories, Wright-Patterson AFB, OH; Air Force Armament Laboratory, Eglin AFB, FL; Air Force Weapons Laboratory, Kirtland AFB, NM; Air Force Rocket Propulsion Laboratory, Edwards AFB, CA; Air Force Geophysics Laboratory, Hanscom AFB, MA; Air Force Human Resources Laboratory, Brooks AFB, TX; USAF School of Aerospace Medicine, Brooks AFB, TX; Air Force Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH; Frank J. Seiler Research Laboratory, USAF Academy, CO; and the Rome Air Development Center, Griffiss AFB, NY. The five major contractors for FY 1986 were: Iowa State University, Ames IA; Stanford University, Stanford, CA; University of

Southern California, Los Angeles, CA; Massachusetts Institute of Technology, Cambridge, MA; Princeton University, Princeton, NJ. In FY 1986, there were 320 contractors with 1,279 contracts or grants, for a total value of $146 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: This program element has thirteen projects in FY 1988 and/or FY 1989. Three projects, 2309, 2311, and 2313 are under $10 million in FY 1988 and FY 1989. Theee projects are included below to provide the full scope of the Air Force Defense Research Sciences Program.

8. (U) PROJECTS OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2301, Physics

A. (U) Project Description: This project provides scientific information to the technology base to help solve Air Force problems in new weapon systems development, electromagnetic countermeasures, nuclear weapons effects, communications, nondestructive and nonintrusive testing and analysis, and new materials development. To provide the necessary scientific knowledge, work is supported in optical physics, plasma physics, atomic and molecular physics, particle beam physics and pulsed prime power generation.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: (1) A picosecond laser technique was devised, demonstrated, and extensively analyzed, for probing signals in very fast digital or analog circuits on compound semiconductors. The technique is noncontacting, is uniquely capeble of meeting speed requirements for existing and planned circuits, and can, uniquely, make such measuremente at arbitrary locatione within a complex circuit. The technique will find extensive applications in deeign of advanced high speed devices and circuits, and in automated testing of such circuits in production. (2) New photochemical processes, taking advantage of the high peak power availeble from eximer lasers, have been devised and demonstrated which can yield one quarter micron resolution lithography. These new processes promise large payoffs in the production of very large scale integrated circuits. They will permit the use of already, well developed and capitalized optical equipment with only slight modifications. This is as opposed to the radical new lithographic procedures previously believed necessary. (3) The Lymann-alpha ultraviolet calibration standard for the dissociation of molecular hydrogen by electron impact has been revised. The established interaction cross section, a fifteen year old calibration standard, was demonstrated to be in error by 31 percent. A three-wave mixing scheme for generating microwaves in a beam-plasma device has been demonstrated. The technique generated 7 to 60 gigahertz radiation by driving a high density helium plasma with two electron beams, each at a potential of 90 kilovolts and a current of 6.5 amperes.

(2) (U) FY 1987 Program: Research will be concentrated in the following physics specialities: Optical Physics (short wavelength lasers, integrated optical/electronic devices, nonlinear optics, x-ray optics); Plasma Physics (x-ray laser plasma sources and millimeter wave plasma sources); Atomic and Molecular Physics (atomic excitation and quenching processes, structure and dynamics of excited atoms, laser-matter interactions); Particle Beam Technology

(accelerators, ion sources, beam propagation and interaction); Multimegawatt Space Prime Power Generation (power conditioning, storage, conversion of thermal energy to electricity, thermal management of waste heat, new electric power concepts for space). In the field of plasma physics a fundamental understanding will be sought for plasma turbulence which blocks effective use of plasmas as reliable sources of coherent millimeter-wave radiation. Work will begin on a plasma physics expert system which will employ a user-friendly, microcomputer-based, graphical, interactive, front-end so plasma physicists can efficiently control the sophisticated, multidimensional simulation codes run on the new classes of supercomputers. The result will be a world-class computational hardware/software "user facility" supplied to DOD researchers, at virtually no cost, for the study of an almost unlimited variety of basic and applied plasma physics questions. A new initiative, using ultrafast spectroscopic techniques, will investigate the microphysics of microelectronic materials, their surfaces and the growth of optical thin films. In Atomic and Molecular Physics, laser cooling and particle trapping techniques will be initiated to study, precisely, the properties of single atoms.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: For FY 1988 the Physics project will continue the advanced research efforts of the past year. In plasma physics neutral and charged plasmas will be studied as potential sources for the efficient generation of millimeter- and submillimeter-wave radiation. This study will entail a continued exploration of the unique physical phenomena associated with plasma turbulence. Methods will be sought for efficiently maintaining plasmas in the atmosphere. For all this work, emphasis will be placed on the use of innovative computer simulations as research tools. Under Atomic and Molecular Physics, emphasis will be on the use of ultrashort (femtosecond) laser pulses to the study collisional processes. Research will be expanded in the areas of nonlinear optics. Selected aspects of nonlinear optical materials, optical phase conjugation, frequency conversion, and switching will be explored. Studies related to soft x-ray laser generation, x-ray optics, and scientific applications of these wavelengths will be continued. Studies of novel optical techniques for processing, process monitoring, and testing of microelectronic circuits will continue to be emphasized.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Research will continue to be concentrated in those physics specialties relevant to future Air Force needs: Optical Physics, Atomic and Molecular Physics, Plasma Physics, Particle Beam Technology, Multimegawatt Space Prime Power Generation, and Advanced Energy Concepts. In Optical Physics nonlinear optical studies will receive expanded emphasis. Special emphasis will be given to nonlinear frequency conversion techniques, with the goal of developing rugged, compact, all solid state lasers for field applications. Programs in x-ray optics will receive continued emphasis, with expected demonstrations of high resolution, element selective, soft x-ray microscopic and holographic imaging, and initial demonstrations of their application to cell and solid surface studies. In Atomic and Molecular Physics, continued emphasis will be placed on the use of ultrashort (femtosecond) laser pulses in the study of collisional processes. In Plasma Physics the study of neutral and charged plasmas will be continued. These types of plasmas are potential sources for the efficient generation of millimeter and submillimeter-wave radiation. Methods will be sought for efficiently maintaining plasmas in the atmosphere. Particle Beam Technology will continue to focus on ion accelerators and sources, and beam neutralization, propagation and interaction. Research on Multimegawatt Space Prime Power Generation will continue to address power conditioning, storage, efficient conversion of thermal energy to electricity, and thermal management of waste heat.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not applicable.

9. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2302, Structures

A. (U) Project Description: This project pursues research directions supporting generic aerospace structure technologies, including structural dynamic-control interactions, nonlinear modeling and analysis, constitutive modeling and fatigue, and fracture prediction of metals, composites, and geotechnical materials. This research will generate new concepts to advance the generic technologies required for durable, superior high-performance weapon systems and installations.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: (1) A new procedure for controlling the pointing accuracy of a spacecraft is four times as robust (insensitive to design uncertainty) as previous methods. The new procedure is based on an improved theory that better accommodates uncertainties in analytical design models. (2) A new model has been developed which accurately predicts transverse cracking in composite laminates. The method, based on strain energy release rate coupled with an initial flaw distribution, is key to accurately predicting the service life of composite structures. (3) New understanding of liquefaction of soils under blast loads will allow more accurate crater predictions. In some cases, the otherwise undisturbed soil around a crater can be transformed by the blast to a liquid and flow into the crater. The new research allows prediction of the onset and extent of liquefaction.

(2) (U) FY 1987 Program: For FY 1987 a new initiative modeling toughening mechanisms for multi-phase nonmetallic materials will address basic constitutive responses, micromechanical deformation, and damage response mechanisms for ceramics, carbon-carbons, and cementitious composite materials. This work is essential to the development of very high temperature composite materials for use in advanced propulsion and hypervelocity flight structures, and in improved pavements and protective structures. Increased research on the microscopic stress-strain behavior in the vicinity of localized structural material damage will seek to improve our understanding of the fundamentals for predicting structural failure. Damage growth observed in well defined specimen tests will yield improved models for predicting damage site development and structural failure. In structural mechanics, interdisciplinary efforts are emphasized. Structure-controls interaction studies for large space structures will be continued. Structure-fluids-controls interactions will receive more emphasis in the context of supermaneuverability and the great potential of harnessing unsteady flow and structural deformation coupling in flight structures. The influence of the physical properties and microstructure of geotechnical materials on their response to loadings will be studied with the objective of improving their resistance to damage. The mechanics of large faulted rock masses subjected to high pressures will be determined and modeled with the objective of predicting and reducing stresses transmitted to buried structures. The influence of soil characteristics on resistance to blast-induced liquefaction

and on load carrying capacity will be sought for improving performance of soil subjected to nuclear and conventional weapons and to aircraft loading.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: An FY 1988 initiative in Hypersonic Flight will address the requirements for very high temperature structures for applications such as the Aerospaceplane. Both cooled nonmetallic and metallic structures will be studied and the effects of coupled thermal and applied structural loads will be addressed. A new effort will be initiated in FY 1988 in pavement technology to address the Air Force's needs for improved performance of runways. The effort will be strongly coupled to the Department of Transportation's Strategic Highway Research Program. Emphasis will be on structural behavior and failure mechanisms of multi-layer systems, and cement and asphalt chemistry, failure mechanisms, and structure-property relationships. Work on the FY 1987 initiative in nonmetallic materials will continue to address constitutive properties, micromechanical deformation, damage response mechanisms in ceramic, carbon-carbon, and cementitious composite materials, and modeling and prediction of toughening mechanisms in multi-phase materials. Structure-controls interaction studies will continue for large space structures. Structure-fluids-controls interaction research will continue emphasizing supermaneuverability and the harnessing of unsteady flow and structural deformation coupling in flight structures. Influences of the physical properties and the microstructure of geotechnical materials upon their response to operational loadings will be studied to improve durability and damage resistance. The influence of soil characteristics on blast-induced liquefaction and on load carrying capacity will be investigated to improve the performance of soil subjected to nuclear and conventional weapons.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: New thrusts for FY 1989 include inhomogeneous constituent material mechanics, deformation of granular materials, and heuristic (learned) structural analysis/synthesis. Efforts in hot structures, metallic materials, and nonmetallic materials research will be continued. Active and passive cooling of hot structures will be investigated using both simulations and coupled mechanical-thermodynamic models. Characterization of constitutive behavior and damage mechanisms in ceramic, carbon-carbon, and cementitious composite materials will be pursued. A new thrust in computational thermo-inelasticity will seek to integrate newly developed capabilities in microstructural constitutive models, macrostructural thermoviscoplastic models, nonlinear field equations of state, and parallel numerical algorithms to provide numerical simulations of high velocity flight and other high temperature structural applications. Structure-fluid-controls interaction research will continue to address stability issues in supermaneuverable flight and nonlinear dynamics and control of large space structures, particularly under deployment and slew maneuvers. Efforts under the FY 1988 Initiative in Pavement Technology will continue to address improved runway performance requirements. Dynamic response of protective structures subjected to impulsive loading will be further investigated. Efforts will also be continued to develop fabric-deformation relations of soils and other geotechnical materials to establish more rational constitutive laws.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not applicable.

10. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2303, Chemistry

A. (U) Project Description: Advances are sought in Air Force technological capabilities in structural and electronic materials, geo-environmental characterization, electromagnetic and conventional weaponry, electrochemical power systems, and rocket propellant ingredients. Specific research emphasizes synthesis and characterization of higher performance, lower cost nonmetallic materials for application as structural composites, lubricants and sealants. A detailed description is sought of atomic level interfacial contamination responsible for limitations in performance of electronic devices. Also under investigation is the reaction chemistry of the upper atmosphere that controls the density of the ionosphere as well as the intensity and spectral distribution of infrared background radiation. These factors limit the reliability of radio communications and sensitivity of satellite surveillance systems. Separate but similar investigations of molecular energy release mechanisms foster advances in laser weapon development.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: A molecular level prototype ceramic composite was developed with silicon carbide reinforcement of silica. The material is formed at room temperature by the cogelation (simultaneous polymerization) of two organometallic precursor polymers that decompose to the fully dense silica/silicon carbide composite at 800 degrees Celsius. The resultant structure shows three to fourfold increase in fracture toughness and hardness over pure silica. The high fracture toughness to weight ratio and ease of processing make the material a candidate for construction of large-scale space structures. A potentially revolutionary new method of processing high strength polymers has been developed based on polymer alloying. The polymers with the highest strengths are difficult to process into desired shapes because the same molecular structure that provides strength also renders the polymer unmeltable at temperatures below its decomposition. New theories on the thermodynamics of polymers are being applied to identify polymer combinations, which when blended yield alloys that can be processed at temperatures below their decomposition point. Application of this approach to polybenzimadozole has removed the processing constraints that previously frustrated widespread application of this high strength structural polymer.

(2) (U) FY 1987 Program: Research in nonmetallic structures will emphasize advanced processing methods for ceramic composite materials for use in aircraft turbine engine hot sections with long service life at high temperatures up to 4,000 degrees Fahrenheit. This effort will address the required synthetic control of submicron scale composition and interfacial structure required for acceptable toughness. The program in polymer processing will emphasize molecular structural concepts impacting electronic and electro-optical properties of liquid crystalline macromolecules for application in high performance optical signal processing systems. The projected effort in molecular kinetics will determine the chemical reaction mechanisms which control the combustion rate of boron slurry fuels. Understanding these mechanisms will permit controlled and efficient burning of boron loaded fuels in future high performance ramjet applications. In addition, a major new effort will determine the causes of infrared emission and exposed surface degradation caused by the energetic collision of spacecraft surfaces with atmospheric oxygen and

nitrogen atoms. Criteria will be developed for future selection of degradation resistant coatings for exposed electronic and optical components as well as for selection of on board infrared surveillance systems of maximum sensitivity operating outside frequencies characteristic of near field surface glow.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Major research thrusts with high payoff to future Air Force technology will be continued. The Ultrastructure Materials research efforts will be strongly emphasized during FY 1988 with the three following major research efforts being strengthened: (1) New structural polymers will be synthesized and the relationships of molecular structure to end use properties determined. (2) Advanced liquid crystalline polymers for application as ultrafast response nonlinear optical (signal processing) materials will be evaluated. (3) New classes of tough ceramic/ceramic composites will be produced by sol/gel processing for advanced high performance turbine engine component applications. New high energy content, long storage life propellant binders will be synthesized. Research on the kinetic mechanisms of thermal decomposition of explosives will result in improved insensitive high explosives. Research on the molecular level oxidation kinetics of fuels will pinpoint the details of energy release and assist design of advanced ramjet engines with higher operating performance. Erosive and luminescent surface reactions encountered in space by satellites will be investigated using laboratory simulations. New research initiatives are planned in high priority areas: metastable molecular energy storage (as a basis for advanced high energy density rocket propellants), low cost synthesis of high performance polymers by application of biotechnology and molecular mechanisms of solid lubrication.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Ultrastructure materials approaches will be applied to new classes of nonlinear optical materials—inorganic compounds and nanometer composite structures containing both organic and inorganic phases. The basis for higher energy density, longer lifecycle space power systems will be sought with expanded research in electrochemistry. Because of the importance of solid lubrication in future high performance turbine engines the research effort on tribology will be expanded. Research on processing ceramics from organometallic precursors by pyrolysis will shift its emphasis to include sources for high temperature materials containing zirconium, hafnium, titanium, and tantalum. Research in spectroscopy and chemical kinetics will seek to support future space-based surveillance systems by characterizing ultraviolet sources in exhaust signatures as well as atmospheric backgrounds.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not applicable.

11. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2304, Mathematics

A. (U) Project Description: The research in the mathematical and computer sciences seeks discoveries to provide understanding and to solve problems of critical importance to the Air Force. The topics include control of aerospace systems; models for the design of aircraft, missiles, or other weapons; efficient production of large-scale,

well-documented computer programs and software; communication and information theory; artificial intelligence in surveillance systems or independent weapons; reliability, availability, and maintainability; and the allocation of resources in logistics or operational activities using optimization theory.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: (1) The decoding algorithm for a Reed-Solomon code can be used to obtain the correct codeword for a variety of burst types of binary errors that occur during the transmission of the codeword through a channel. This error tolerant property makes the decoding algorithm useful in many communication and computer systems. A recent new implementation using Galois field theory has resulted in the design of a new encoder which can be realized readily on a single very large scale integrated chip. (2) Control systems are designed based on mathematical models of the dynamics of a physical process which always involve some uncertainty (e.g., wind gusts, aerodynamic coefficients, etc.). Robust control systems must provide high performance over a wide range of operating conditions (uncertainties). Recently some new nonlinear robust control concepts have been developed which provide a simple controller design which can compensate for unknown parameter changes as well as nonlinear effects. The regulator is easy to implement and has been incorporated in the control system of certain industrial robots. (3) A new, faster, more easily implemented version of the finite element methods has been developed for problems in plane linear elasticity arising in such areas as the stress analysis of aircraft structures. The p-version differs from the more traditional approach by using hierarchical systems of elements of higher polynomial order. As a result, a faster, robust method was developed with the extra advantage of having an established mathematical framework for estimating and controlling the error of approximation in terms of the energy norm.

(2) (U) FY 1987 Program: A major enhancement of the program in mathematics will emphasize research in parallel algorithms for multiprocessor computers, large scale optimization, and computational statistics. Emerging computer architectures offer a radically different approach to achieve needed performance improvements. However, traditional algorithm designs do not perform efficiently on the new machines. Techniques to utilize the multiprocessing capabilities of these machines are sorely needed, especially for algorithms to solve large problems in mechanics, physics and chemistry involving complex systems of partial differential equations. The optimization thrust will incorporate and extend recent results on optimization's mathematical foundations which offer great promise for applications to resource planning and scheduling and to optimal design of aerospace systems. The new effort will seek practical, efficient algorithms for optimization on modern computers. The large computational systems now available present an unparalleled opportunity to study and use new, faster, more accurate, and more robust statistical estimating approaches with applicability to more general distributions of data. These computationally based statistical approaches need to be developed to predict the reliability and maintainability of complex systems such as aerospace vehicles and communication networks. Methods to improve the power, quality, reliability, and transportability of computer software for numerical and symbolic processing will also receive emphasis.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: A major enhancement of the program in mathematics will emphasize research in nonlinear phenomena with particular emphasis on coherent nonlinear waves, nonlinear dynamics (chaos) and the attendant fractal descriptions. These three paradigms have emerged as the major

breakthroughs in the effort to understand nonlinear continuum mechanics and electrodynamics. The bifurcation of coherent waves into temporal and/or spatial chaos provides a remarkable description of phenomena such as clear air turbulence and nonlinear bistable (laser driven) optical devices. This new effort will seek both analytical and numerical approaches to the questions posed by modern technology and encapsulated in the nonlinear partial differential equations written as models. A new initiative in the artificial intelligence program will emphasize research in neural architectures and processing. Artificial intelligence has had notable successes in producing systems that rival, or even exceed, human performance in specific, problem solving domains. However, the continued use of uniprocessor systems will present an insurmountable obstacle to future progress, particularly in the area of large knowledge-based systems, speech understanding, large and robust natural language processing systems and computer vision systems. The theoretical maximum performance of uniprocessor systems is several orders of magnitude below the performance levels required for desired systems. Furthermore, uniprocessor systems are not fault tolerant. A new computational paradigm is needed that is intrinsically parallel and fault tolerent. Highly connected, asynchronous, memory distributed architectures, suggested by neural systems, offer promising approaches for overcoming the limitations of uniprocessor systems. This initiative will support research on neural based architectures for artificial intelligence processing, which strongly underpins Air Force emphasis on knowledge based systems technology. Projects of interest range from those concerned with developing mathematical theories of how self-organization and learning proceeds in neural networks to simulations that provide a secure foundation for designing hardware implementations, to physical realization of architectures. Enhancements to ongoing high quality initiatives and core enhancements in computational mathematics, artificial intelligence, large scale optimization on computers, computer aided quality control, distributed parameter control and expert systems will continue to be emphasized in the planned FY 1988 program. Supercomputer technology and availability will continue to have a major impact on the investigators who are seeking solutions in computer architectures, large algorithms, expert systems and optimization theory.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Parallel algorithms for large-scale optimization will be a new research initiative topic in FY 1989. Emphasis will be put on developing new optimization techniques for the nonlinear optimization problems prevalent in Air Force applications. Methods for properly scaling the search domain and for handling the inequality constraints will be pursued. As a natural continuation of our emphasis on developing algorithms for the emerging, powerful multiprocessor computers, the optimization codes developed under this initiative will be targeted at such machines. Acoustic and radar scattering together with tomographic nondestructive evaluation will also be a new research thrust in FY 1989. Recent conceptual breakthroughs in this field offer great potential benefits. Contributing to the knowledge-based systems technology the work on expert systems will increase emphasis on handling application domains that have an inherent time-dependence such as is typical in real-time problems (system monitoring, target acquisition, pointing, and tracking, etc.). Complex Air Force applications include such parameter dependent problems as structural buckling, nonlinear optics, and the Navier-Stokes equations describing fluid flow. In addition to pursuing promising new approaches to obtaining qualitative results for such problems, emphasis will be placed on novel computational techniques that are effective in tracing out solution manifolds for these challenging applications. Continued emphasis will be placed on such fundamental, ongoing problems such as providing parallel programming environments in this new multiprocessor computer era, control of distributed parameter systems for problems modeled by partial differential equations, improved

communications techniques over noisy and degraded channels, and statistical methods that allow for more realistic models of system reliability. A new effort in spatial statistics will be started. Emphasis will be on developing new statistical procedures to interpret and analyze large data sets in the multi-dimensional space-time domain. This emphasis will support many of the new technologies and systems which require real-time synthesis and analysis of data collected by multiple sources.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not applicable.

12. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2305, Electronics

A. (U) Project Description: Electronics research provides fundamental knowledge required to advance Air Force capabilities in surveillance, guidance and control, information and signal processing, electronic warfare, and communications, command, and control. Research topics include optical signal processing for target recognition and terminal guidance, semiconductor devices for high speed digital and analog signal processing, and microwave and millimeter wave signal and power generation, electromagnetic propagation, antennas, target signatures, microwave tube science, superconducting analog signal processing, robust communications techniques for command and control, and nuclear radiation hardening of electronic circuits and devices.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: (1) Single mode integrated optics micro-lenses and micro-lens arrays were developed and fabricated. This solves one of the major problems inhibiting progress in integrated optical computing circuits: The lack of high performance lenses and lens arrays built right into the integrated optical chip. The new technique uses titanium indiffusion and proton exchange processes to form micro-lens shaped optical waveguides which can direct light in the chip for appropriate processing. A prototype optical integrated modulator has been built and shows that the concept can be scaled to large optical systems. (2) Gallium arsenide (GaAs) single crystal films have been grown on non-lattice matched silicon substrates. The increased need to combine signal processing in silicon integrated circuits with optical gallium arsenide circuitry and optical fibers necessitated a search for a hybrid technology of silicon and gallium arsenide on one chip. In this effort, a careful study of growth, crystal lattice parameters and interface physics culminated in the understanding and control of high quality gallium arsenide growth on silicon, two radically dissimilar materials. Electronic devices fabricated on the new materials structures performed favorably compared to the best available conventional devices. (3) A high performance indium gallium arsenide (InGaAs)/aluminum gallium arsenide (AlGaAs) quantum well field effect transistor has been developed and fabricated by molecular beam epitaxy. The electrical performance (transconductance) was found to be twice that of standard quantum well field effect transistors. This is due to the fact that the InGaAs supports much higher carrier speeds than found in standard GaAs quantum wells. Further research accomplishments consisted of developing detailed

insights into the atomistic nature of the interface between InGaAs and AlGaAs. (4) The frequency response of a permeable base transistor (PBT) has been substantially increased by applying well known fluid dynamics principles to electron transport in the PBT. The successful use of this analogy provides insight into the flow of electrons in the PBT and pinpoints potential areas where the flow is inhibited due to hydrodynamic considerations. New simulations, suggested by this analogy, have further verified the advantage of using hydrodynamics to model electronic device performance. (5) The roughness of quantum well walls has been accurately determined and can now be used for a prediction of tailored properties of superlattices. This roughness has a strong effect on quantized energy levels within the well and thus determines the optical response of wells used, for example, as far infrared detectors. Similarly, high resolution optical techniques have been used to resolve the fluctuations in quantum well widths. Fluctuations of about one atomic layer have been detected by this new technique, making it a very powerful tool for investigation of quantum well structures.

(2) (U) FY 1987 Program: The considerable Air Force need for faster signal processing capabilities will be addressed by research program expansion in three promising signal processing technologies. The Monolithic Millimeter Wave Integrated Circuit initiative will expand to examine the scientifically challenging interdisciplinary issues arising when the semiconductor device size is comparable to the electromagnetic signal's wavelength. Success here could result in a complete radar array on a single semiconductor wafer. Another new signal processing technology based on superconducting signal paths promises an order of magnitude higher operating frequencies. Research will focus on defining circuit and device designs. The ongoing program in optical signal processing will be reoriented from purely analog processing toward optical computing. By taking advantage of the inherent parallelism in optics, computer architectures impossible or impractical with conventional electronics may be constructed with many orders of magnitude improvement in processing capacity. Underlying support for signal processing will be provided by programs in physical electronics. Here, the emphasis is directed toward understanding physical phenomena exploitable in electronic and optical devices. Two new directions in physical electronics involve semiconductor structures with dimensions less than a tenth of a micrometer. The first will examine quantum well structures to understand the role of electron tunneling in transport, a mechanism that promises transport times in the femtosecond range. The second, semiconductor superlattices, will be studied for the promised ability to independently design their electrical and optical properties. Room temperature infrared detectors could result. Finally, because many Air Force electronic and optical devices use thin films of various devices, an initiative in Thin Film Sciences will be started. Understanding the interaction between the depositing film atom and the substrate could lead to the ability to deposit more materials with higher quality and at lower temperatures. Benefits for Air Force high power laser systems include higher laser damage threshold optics.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The FY 1988 program will be increasingly directed toward the Air Force needs in adaptive signal recognition and processing. Consequently, research will be supported on materials and devices which will improve photonic and electronic signal and data processing functions, on transmission of data and on signal processing sciences which emphasize the programmability and massive parallelism needed to support the development of knowledge based systems technology. Research to be pursued will impact on future technologies to provide for "intelligent" weapons targeting and guidance systems, fault tolerant systems and support missions requiring artificial intelligence electronic materials and device research will

emphasize structural dimensions between one-tenth of a micron and a few angstroms. This quantum size domain requires ultimate control of structural quality such as defects, dislocations and abruptness of interfaces. Novel devices, particularly for millimeter wave applications in support of Wafer Level Union, will be pursued making use of new carrier transport phenomena expected to be observed in those quantum structures. Also new approaches to integrated circuits based on quantum tunneling and hot electron effects will be supported. Tailoring materials properties for new optical, electronic and magnetic devices will be accomplished. The reliability and radiation hardness of these new devices will be carefully analyzed. In addition to maintaining the present overall program emphasis, a new initiative is planned in neural architectures and signal processing. This effort aims at approaches which are adaptive, self-learning and massively parallel and thus supports the urgent need for novel ideas in artificial intelligence and integrated photonic systems.

(4) (U) FY 1989 Planned Program and Basis For FY 1989 RDT&E Request: Fundamental research in electronics will be focused predominantly on optical and millimeter wave implementations of highly efficient novel architectures. Device physics and problems arising from fabrication of ultra-small devices will be studied and applied to the spectral windows of interest. Superconductive electronics will be investigated and compared with existing standard electronics. Strong emphasis will be on matching signal processing algorithms and architectures to the chosen hardware implementation for overall systems performance. Propagation issues will be analyzed that impact radar scattering or adaptable radiation pattern control in adverse environments. This program is well coordinated within the AF laboratories.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not applicable.

13. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2306, Materials

A. (U) Project Description: The materials research program provides the knowledge required for improving the performance, cost, and reliability of structural and electronic materials. The structural materials research program studies a broad range of material properties, such as strength, fatigue resistance, and corrosion resistance of airframe, turbine engine, and spacecraft materials. Emphasis is on titanium, aluminum, and nickel-based alloys, advanced composites and ceramics. Research in new production methods and nondestructive evaluation of these materials complements research on materials properties. The electronic materials research program is concerned with semiconductor, optical, and magnetic materials used in avionics, surveillance, communications, guidance, and electronic warfare. Emphasis is on compound semiconductors, superconductors, materials for infrared fiber optic systems and nonlinear optical materials for signal processors.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: (1) The fracture toughness behavior of magnesia-partially stabilized zirconia has been examined as a function of subeutectoid aging heat treatment. Appropriately aged specimens exhibit up to 0.1 percent permanent strain before failure and have fracture toughness approaching 15 megapascal root-meters, a factor of five improvement over the previous base ceramic. Furthermore, the stress-induced transformation which provides this increased toughness has been shown to be reversible. These results demonstrate that toughening a class of ceramics potentially capable of functioning as high temperature structural materials may be possible. (2) The kinetics and mechanisms relating to subsurface void formation in Inconel MA-754 by high temperature exposure have been determined. Correlation of the void area fraction profile with the measured chromium depletion through a diffusion analysis indicates that void formation is due to vacancy injection and is not dependent upon the presence of oxide dispersions. This research provides insights into the improvement of material and design specifications, prevention of premature failures of engine components, establishment of more effective guidelines regarding engine maintenance schedules, and development of future generations of high temperature structural materials. (3) A Dynamic Material Workability Model has been formulated by making use of fundamental principles of irreversible thermodynamics, continuum mechanics, and stability and bifurcation theory. The model has been applied successfully to nearly eighty different materials including gas-turbine compressor disk materials, rapidly solidified aluminum alloys, composite materials, memory alloys, Pyrex and other ceramic glasses, and polymeric materials. The modeling effort has made possible the generation of processing maps and has led to economical methods of achieving product quality, improved process control, and lower reject rates. Advanced systems will derive significant performance, reliability, scheduling, and cost improvements from these efficient materials processing capabilities. (4) Electronic devices are fabricated in the region near the surface of a semiconductor wafer and are therefore susceptible to damage hidden below the surface. A laser technique called Variable Angle Scatterometry has been developed that permits, for the first time, the nondestructive testing of this subsurface region of the semiconductor. Since laser light penetrates slightly into the semiconductor before being reflected, the quality of the reflected light gives a direct measure of the quality of subsurface semiconductor material. (5) Compared with the electronic properties of semiconductors, the mechanical properties have received much less attention. Realization of the fragility of the new semiconductor Gallium Arsenide as compared with conventional silicon has spurred interest in this area. A theoretical methodology has been developed that treats elastic moduli, hardness and perhaps fracture of these materials in a realistic manner. The theory was developed from fundamental considerations of atomic bonds under mechanical distortion and has proven particularly powerful in predicting the mechanical properties of semiconductor alloys.

(2) (U) FY 1987 Program: In addition to maintaining the present overall program emphasis, new thrusts are planned in the understanding of the effect of microstructural properties on macroscopic structural materials behavior. Attempts will be made to quantum mechanically formulate and understand interatomic bonding in alloys. A new program aimed at the understanding of microstructure in ceramics, composites, and hydraulic cements will be initiated. The ultimate goal here is to better control brittleness and fracture resistance of these materials. The general understanding of microstructural behavior will enable the structural designer to select the best, most reliable materials required to meet specific Air Force missions. In the area of electromagnetic materials emphasis continues on those materials issues that influence device behavior. In particular, research leading to an understanding of certain defects in compound semiconductors and superlattices and the role of processing on performance parameters will be strengthened. Research will expanded in the areas of high temperature structural

materials and electromagnetic materials.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: In addition to continuing the successful investigations, new thrusts are planned to develop understanding of the effects of microstructure on macroscopic behavior of structural materials, particularly as related to hybrid materials composed of heterogeneous and multiphase microstructures. Attempts will be made to fundamentally model as well as quantum mechanically formulate and understand surfaces and interfaces in materials. In-depth understanding of microstructural behavior will enable the structural designer to select the best, most reliable materials required to meet specific Air Force missions, especially in the important areas of engines and structures for hypersonic flight. The overall program continues to emphasize evolutionary improvements in existing materials while searching for revolutionary new classes of materials. In the area of electromagnetic materials, emphasis continues on those materials issues that influence device behavior. In particular, research leading to an understanding of thin films and artificially structured materials and the role of processing on device parameters will be strengthened. Research will continue on high temperature structural materials and electromagnetic materials.

(4) (U) FY 1989 Planned Program and Basis For FY 1989 RDT&E Request: Research on very high temperature structural materials for skins of high mach number aircraft and for advanced propulsion systems, and on material issues that impact on electromagnetic device behavior will be emphasized. Metal, ceramic, carbon-carbon, cement and hybrid material issues will be pursued, as well as processing science on structural and electromagnetic materials. Continuing emphasis will be maintained on high temperature structural materials and electromagnetic materials. Experimental research activities will be initiated to confirm successful output of first-principles computations of physical and mechanical properties of materials.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not applicable.

14. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2307, Fluid Mechanics

A. (U) Project Description: Fluid mechanics research provides knowledge essential for improving the efficiency and effectiveness of Air Force flight vehicles. The research seeks to provide physical understanding of key flow phenomena, to devise improved theoretical models based on that understanding, and to originate concepts which will expand current aerodynamic performance boundaries. Future directions in aircraft performance requirements will include better range and fuel efficiency, capability to operate from shortened or damaged runways, capability to maneuver in the post-stall flight regime and capability to fly at sustained hypersonic speeds. These technology needs motivate research directions to better understand aerodynamic drag generation in turbulent flows, the characteristics of jet-interacting flow fields, convective heat transfer in gas flow, the characteristics of time dependent, three-dimensional separated flow and the computation of flows with nonequilibrium chemistry. The results of fluid

dynamics research will provide the background necessary to assure the design and production of superior flight vehicle weapons systems.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: (1) A new numerical method allows accurate computation of the flow field around a rapidly pitching airfoil. This unsteady flow regime, for which lift enhancements of 100 percent have been demonstrated, is important for development of future highly maneuverable tactical aircraft and missiles. (2) Using computational simulation, we have recently been able to predict the detailed structure of the onset of turbulence. This understanding will allow us to modify such flow and reduce the effect of turbulence on vehicles and in engines. (3) The heat transfer on a concave surface such as a gas turbine blade is 40 percent higher than for a flat surface. Recent research has identified the surface fluid flow structure which explains the enhanced heat transfer. Such insight will allow development of flow control schemes to modify the structure and beneficially change the heat transfer.

(2) (U) FY 1987 Program: Major emphasis will continue on investigations of unusual flow separation phenomena responsible for extremely high lift levels of wings undergoing rapid, large amplitude motions. Productive exploration of these phenomena could lead to significant improvements in flight vehicle maneuverability. Research will focus on dynamic stall of three-dimensional lifting surfaces and generic characteristics of driven unsteady separated flows. The capability for real-time active control of isolated separation vortices will be sought. New directions within the ongoing turbulence program will include numerical simulation of time-evolving turbulence features, development of new analytical and computational approaches for simulating the initiation of turbulence in shear layers, and new methods for actively and interactively controlling turbulence characteristics. Better understanding of the structural features of turbulent shear layers has potential technological impact in such areas as skin friction drag reduction and control of turbulent mixing. In the computational fluid dynamics program, increased effort will be directed toward control of numerical error through such means as solution adaptive grid methods and multigrid procedures. Algorithm development for faster computing speeds will be driven by the opportunity to exploit new supercomputer architectures which feature increased parallelism. Faster and more accurate computational fluid dynamics methods will provide a powerful tool for development of new generations of flight vehicles. In the internal fluid dynamics program, new work will focus on the role of flow field unsteadiness in the generation of losses in axial flow compressors. Experimental and computational approaches will be pursued to identify the loss mechanisms that are driven by blade motion. Continued emphasis will be placed on developing improved methods for prediction of heat transfer to turbine blades.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: An FY 1988 initiative in Hypersonic Flight will emphasize the real gas effects in hypersonic aerodynamics and the complex airframe propulsion system integration, especially with respect to shock interactions. Emphasis will continue on investigations of unusual flow separation phenomena responsible for extremely high lift levels for wings undergoing rapid, large amplitude motions. Research will focus on dynamic stall of three-dimensional lifting surfaces and generic characteristics of driven unsteady separated flows. The capability for real-time active control of isolated separation vortices will be

sought. Better understanding of the structural features of turbulent shear layers has potential technological impact in such areas as skin friction drag reduction and control of turbulent mixing. Algorithm development for faster computing speeds will continue in an effort to exploit new supercomputer architectures. Faster and more accurate Computational Fluid Dynamics methods will allow development of new flight vehicles. In internal fluid dynamics research, experimental and computational approaches will be pursued to identify the loss mechanisms that are driven by blade motion.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: A new thrust in interactive flow control will provide the basis for control of aerodynamic flows, mixing, and combustion. Research in nonlinear flight mechanics will provide the basis for future high maneuverability vehicles. Research will continue in hypersonic aerothermodynamics with emphasis on real gas effects, strong viscous interactions and transition to turbulence in high speed boundary layers. Research on unsteady separated flows will continue to explore the generic characteristics of driven separation in three dimensions, with increasing emphasis on real-time active control of separation vortices. This research along with studies of control of turbulent mixing of shear layers and improved heat transfer prediction in turbine blade rows will support higher performance propulsion systems. Major emphasis on improved understanding of the structural features of turbulent shear layers will continue due to the potential technological impact on the performance of most fluid mechanic devices of interest to the Air Force.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not applicable.

15. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2308, Energy Conversion

A. (U) Project Description: This project is concerned with reacting flows, combustion, and energy conversion in propulsion, weapon and power systems. It includes both airbreathing combustion and non-airbreathing chemical rockets, as well as propulsion systems using electrical, nuclear, laser, or solar energy sources. New knowledge is sought for the use of advanced liquid, slurry, and solid chemical propellants for improved performance and safety. Technology needs include reduced exhaust signature, control of combustion instabilities, reductions in maintenance costs, and improved performance and durability. New diagnostic measurement capability is needed for both laboratory research and on-board control. The goal is to reduce the cost and to increase the flexibility, durability, and performance of future Air Force systems.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: (1) A new laser based diagnostic method allows simultaneous measurement of velocity and pressure at many points in a flame. The technique uses crossed laser beams and detects velocity by doppler shift and pressure by frequency variation. (2) Current combustion prediction methods assume the reaction

chemistry is infinitely fast compared with the mixing rate. While this accurately predicts combustion behavior for low molecular weight fuels such as hydrogen, errors of more than 500 degrees Fahrenheit in flame temperature have been demonstrated for heavier hydrocarbons. Recent research involves modifying combustion models to account for finite rate chemistry. (3) A fivefold reduction in the erosion of a magnetoplasmadynamic (MPD) space thruster electrode has been demonstrated by modifying the arc-spot distribution and motion by doping with thoria. Electrode life and efficiency are critical items to MPD thrusters which promise a fivefold increase in propulsion efficiency.

(2) (U) FY 1987 Program: FY 1987 plasma-based propulsion and combustion enhancement initiatives will promote growth in nonchemical rocket propulsion, supersonic airbreathing combustion and the utilization of boron fuels. The plasma-based propulsion initiative will emphasize development and control of stable plasmas and electrode phenomena. The combustion enhancement initiative will emphasize chemical kinetics, mixing phenomena and shock wave/heat release interactions. The FY 1985 Initiative in Gas Turbine Hot Section research will continue with emphasis on simulating turbulent reacting flows, inhibiting soot formation and producing durable nonmetallic materials. Research in space propulsion will include thermal management, plasma stabilization and thermionic energy conversion. This research will provide the necessary knowledge to obtain the fourfold increases in orbit-raising propulsion efficiency needed for the large communications and surveillance satellites. Attention will be given to advanced diagnostics for performing research on energetic materials, particularly rapid condensed phase processes. Research will continue on new techniques which are essential in understanding combustion systems, air breathing and rocket engines, and effective fuel use. Continuing research will be directed at the dynamics of high-speed turbulent steady-state flows and transient chemically reacting flows with emphasis placed on realistic modeling and characterization of the flow field, processes, and phenomena occurring in dump-type ramjet, gas turbine, and ducted rocket combustors. Efforts relating to rocket combustion dynamics will continue to be emphasized with the goal of improved performance. These studies will lead to higher performance, more reliable, less detectable rocket motors.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Growth is projected for nonchemical rocket propulsion and supersonic combustion. The latter growth will be implemented through the FY 1988 initiative on hypersonic flight. Emphasis will be placed on photochemical means for ignition and flameholding in supersonic combustion devices while simultaneously reducing thermodynamic efficiency losses associated with these processes. Multidimensional modeling of plasma propulsion physics also will receive priority attention. Other areas of interest in rocket propulsion include thermal management synthesis of energetic materials and control of combustion instability.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: A new thrust in interactive flow control will provide the basis for more effective combustion control. Research results to understand the limitations of mixing and combustion under supersonic flow conditions achieved with the support initiated in FY 1987 will be coupled to advances in mathematical chaos and control theory to enhance the rate of energy release in scramjet propulsion systems. Growth will continue according to the FY 1987 initiatives in combustion enhancement and plasma-based propulsion, the FY 1988 initiative in hypersonic flight and the other priorities established in FY 1988.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not applicable.

16. (U) PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2309, Terrestrial Sciences

A. (U) Project Description: This project provides basic research in geodesy, gravity, and seismology to understand the problems associated with increasing missile accuracy. Research in geodesy is required to determine the exact position of targets with respect to missile launch sites. Research in gravity is required to determine its effect on missile guidance systems along flight paths. Research in seismology is required to determine the effects of earthquakes, nuclear explosions, and other natural or system-generated noise on the degradation of missile guidance systems before launch as well as on other Air Force systems and facilities.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: (1) Data from earthquakes in the Aleutian Islands has been analyzed to measure and map the stress release between the converging Pacific and North American tectonic plates. Seismicity along the Aleutian Island arc delineates seismic gaps which are the predicted locations of very large earthquakes. Large events in the Aleutians radiate strong surface waves that can and have disturbed sensitive Air Force systems. These studies afford an accurate prediction of the amplitudes and duration of seismic waves expected from a giant Aleutian earthquake. Furthermore, by extending knowledge of earthquake faulting mechanisms, this work advances seismic verification for test ban treaties. (2) Several million altimeter measurements from satellites have been analysed to determine the mean shape of the earth's oceans to better than one meter, to model variations of the major ocean tides and to map the ocean's bottom. The sea level shape is mathematically translated into a map of gravity over the oceans and used to improve the DOD gravity base which is used for targeting ballistic missiles. Results and allied software are being delivered to the appropriate DOD agencies.

(2) (U) FY 1987 Program: Satellite radio receivers will be operated from astronomic observatories in the United States and Europe to define highly accurate satellite orbits. Initial studies will be completed for instrumentation of the space shuttle to provide gravity over polar and continental areas. A prototype six-axis, supercooled accelerometer will be available for testing as part of a space-borne gravity measurement system. Testing of a portable astronomic azimuth and latitude sensor using a laser gyro will be completed. Free-fall testing of an advanced gravity gradiometer will begin. Results of laboratory measurements of the gravitational constant will be available. Data from several large high explosive tests will be studied to measure explosion-to-seismic wave coupling. The role of velocity anisotropy, attenuation, and scattering on the propagation of seismic waves will be assessed theoretically and observationally. Available seismic data from early atmospheric nuclear explosions will be studied to further examine explosion to ground coupling. Time dependence of 100 to 500 second earth noise will be monitored to search for "slow" earthquakes, unaccompanied by normal events. Long-term deformation of the tectonically active California coast will be measured using an array of Global Positioning System (GPS) receivers. Gravity variations due to tectonic motions will be studied using a continuously recording, super-conducting gravity meter.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The nature of the seismic coupling between the ground and surface and air explosions will be studied using Air Force Geophysics Laboratory (AFGL) observations of several Defense Nuclear Agency nuclear simulation tests. Results of AFGL seismic experiments in Maine, New Mexico, and Nevada will be used to infer properties of the crust in these areas. Maine is a geologic analogue of the Soviet Union, while Nevada and New Mexico are potential small missile basing sites. Portable Global Positioning System (GPS) receivers will be used to measure the earth's viscoelastic rebound following the 1959 Hebgen Lake, Montana earthquake. Testing of the six-axis cryogenic accelerometer will begin. This instrument will be a major component of a space-borne gravity gradiometer (jointly developed with National Aeronautics and Space Administration) to be mounted in the space shuttle for global measurements of the earth's gravity field. Such data permits improvement in ballistic missile accuracy. Final assembly will begin on an automated astronomic azimuth/latitude device using a laser gyro as the sensor. This instrument will have potential application for Defense Mapping Agency field use in weapons siting. Several experiments will be completed to confirm or deny the gravitational "fifth" force. The existence of such a force carries profound implications for all of classical physics as well as for current theories of the earth's gravity field. Testing of a new design gravity gradiometer will be completed with NASA's assistance at the Marshall Space Flight Center. This instrument will have potential as an air- or space-borne instrument. GPS radio receivers will be located at a European Astronomic Observatory increasing our GPS coverage for refining satellite orbits. Orbital accuracies in the order of one part in 10^8 are envisioned. GPS orbital data will be supplied to the GPS program office at Space Division.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Research in Terrestrial sciences will be concentrated in geodesy, gravity and seismic motion. In the geodetic sciences, research will be aimed at improved position location for regions where GPS receivers cannot be placed. GPS location techniques will also be used to further study stresses and earth motion in tectonically active regions. The Air Force Geophysics Laboratory (AFGL) will investigate accurate GPS positioning and location determination for arrays of small satellites. The study of gravity will concentrate on the region of the atmosphere between high altitude (approximately 100,000 feet) and the surface of the earth. This effort will more precisely define the actual gravity vector in magnitude and direction above the surface of the earth. Seismic studies will address source mechanisms and source seismic signatures. AFGL will continue to study the earth's crust in New England as well as study crustal motion associated with Defense Nuclear Agency nuclear simulation tests.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not Applicable.

17. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2310, Atmospheric Sciences

A. (U) Project Description: Research in the atmospheric sciences includes the physics, dynamics, and chemistry of processes which determine the structure and variability of the earth's atmosphere. Atmospheric properties such as

wind, density, clouds and precipitation, ionization, and optical and infrared transmissivity and emissivity all affect the performance of Air Force systems. A major effort is devoted to the development and use of new measurement techniques and the development of models for predicting weather and other atmospheric conditions. Emphasis is placed on understanding atmospheric effects on optical and infrared weapons systems and on understanding the dynamics and structure of the ionosphere which affect communications and surveillance systems.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: A new model for global prediction of maximum electron concentration in the ionosphere has been developed and adopted for operational use by Air Force Global Weather Central to forecast routinely the reliability of satellite-to-ground radio communications. The model ("ICED" for ionospheric conductivity and electron density) takes as input the index of geomagnetic activity as well as available sparse and highly localized observations of electron density (ionosonde observations, incoherent scatter radar data, topside satellite sounder data). It computes local electric fields, currents, and Joule heating. The output is a detailed world-wide map giving electron density as a function of altitude, longitude, and latitude. A second achievement concerns identification of a significant source of background radiation in the auroral ionosphere. Knowledge of the chemical source is essential to forecasting the background that limits the sensitivity of surveillance sensors operating at or near that frequency. Past efforts to model emission from the aurora have postulated the reaction of oxygen molecules and nitrogen ions as the principal source of green emission. Detailed, controlled laboratory research on the chemiluminescence of this reaction revealed no green emission however. Instead the experiment revealed the reaction to be a major source of red emission that also occurs in the active Aurora Borealis. These achievements contribute directly to the overall goals of the Project Forecast II technology on the full spectrum ultra resolution sensors.

(2) (U) FY 1987 Program: Research will continue to emphasize mesoscale weather processes and ionospheric dynamics. Models of mesoscale systems will be based on measurement campaigns conducted in the Rocky Mountains and other plateaus, and data from mesosphere-stratosphere-thermosphere radar systems, to produce a deeper understanding of the physics underlying battlefield scale meteorology. Cloud and precipitation system structure and development will be studied with a Tri-Service supported cloud simulation chamber and dual polarization radars to increase knowledge regarding water droplet scavenging, aerosol formation, and optical infrared properties. Such studies will contribute to more accurate weather forecasts and increased combat success. Field experiments will continue to investigate high altitude wave-like sources of infrared clutter which interfere with surveillance and targeting systems. Multi-station incoherent scatter radar campaigns will probe the physics and dynamics of ionospheric and auroral sources. Theoretical and modeling investigation will augment data analysis and set the stage for increased effectiveness of trans-ionosphere communications and surveillance systems. These advances are essential to support future technologies and systems, such as hypersonic performance, high altitude long endurance aircraft, and space object identification.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Major research thrusts with high payoff to future Air Force operational capabilities will be continued. Accurate analysis and forecasting of irregularities in the ionosphere will be sought. Global scale description of the time varying structure, composition,

and dynamics of the ionosphere, but with special emphasis on the auroral region, will afford accurate prediction of the reliability of radio frequency communication. Understanding will be sought of the basic chemical and physical processes in the upper atmosphere responsible for optical, ultraviolet, and infrared (IR) background radiation in order to assist development of the most sensitive, reliable space-based and airborne multispectral surveillance systems. Special concern will be placed on the complex origins of oscillatory patterns in IR emission for active/passive broad spectrum signature control. Field observations will be combined with laboratory simulations and theory. Research in meteorology will continue to shift from global scale to mesoscale (battlefield scale) forecasting of increasing accuracy and longer lead time. Emphasis will continue on explicit incorporation of moisture in the model to afford accurate predictions of cloud formation and precipitation, data essential for employment of pulsed and directed energy weapons.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Research will continue to focus on efforts needed to provide the technical basis for environmental support to advanced technologies and future systems. Better analytic and predictive capabilities are needed in the upper stratosphere and the ionosphere to more accurately specify electron density profiles, especially when associated with geomagnetic storming which can adversely impact sophisticated communications systems, low orbiting spacecraft, and other systems sensitive to the effects of the near earth space environment (e.g., advanced aerospace plane, pulsed and directed energy weapons, etc.). New breakthroughs are also needed in order to remotely sense atmospheric density and aerosols and specify them over any given point at any time along any path to provide necessary guidance for optimum utilization of state-of-the-art electro-optical and radar systems. Future battlefield weather support will require sub-mesoscale, asynoptic analysis and predictive capabilities to enable the field commander to use his forces and weaponry efficiently; new data assimilation, modeling, and dissemination techniques are essential to support advances such as the super cockpit, brilliant guidance, and other knowledge based systems.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not applicable.

18. (U) PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2311, Astronomy and Astrophysics

A. (U) Project Description: This project provides basic knowledge of the space environment for the design and calibration of advanced Air Force systems. It also supports the Air Weather Service by improving observing and forecasting techniques that support operational military systems. Space environmental conditions produced by radiation and charged atomic particles can endanger the mission and degrade the performance of military spacecraft, disrupt the detection and tracking of missiles and satellites, distort communications, and interfere with surveillance operations. Experimental and theoretical means are used to study methods to improve space surveillance systems and to study solar outbursts and their travel to the earth where they affect communications and satellite systems. Also being studied are the composition of the space environment in which Air Force systems operate, changes caused by

natural and man-made disturbances, and the response of spacecraft systems and operations to the space environment.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: (1) A study of an active region on the Sun using data of the magnetic fields and of the red light from glowing hydrogen has found that all of the flares in the active region were initiated at sites where small fragments of the magnetic field were cancelling. This accomplishment offers new possibilities for a major advance in solar flare prediction. Solar flares are solar disturbances which produce high speed streams of protons and electrons which, upon impacting the Earth's space environment, can deleteriously affect Air Force communications and satellite operations. (2) Using the unique capabilities of the solar observatories at Sacramento Peak and the high-altitude solar observatory in Hawaii, data has been obtained which shows that the corona rotates independently of the solar surface beneath it, which suggests control of coronal features by subsurface phenomena. The results also show that coronal areas that produce very energetic flares are characterized by a coronal canopy of three to four million degrees. This work will make an important contribution to the understanding and prediction of solar coronal disturbances that severely degrade the operation of Air Force communication systems.

(2) (U) FY 1987 Program: The development of solar activity satellite experiments, including the design of a high resolution vector magnetograph for observations of solar active regions that produce major disturbances on Air Force systems, will continue. Solar atmospheric modeling will be used to discriminate among the various possibilities for energy transport during flares, and to determine the signatures for energetic ejections that effect high latitude command, control, communications and intelligence systems. A study will be completed on the uses of radio-star. scintillation observations and observations of interplanetary disturbances from an interplanetary platform to improve predictions of geomagnetic disturbances which degrade Air Force operational satellites. A study will be completed on periodicities in coronal activity that will improve predictive capability of flares and solar mass ejections. Real-time active optical systems will be used to obtain high-resolution images of solar magnetic fields and dynamical motions, and to deduce the physical processes occurring in active regions that affect Air Force systems. Studies of the injection of solar accelerated particles into interplanetary space continue, with specific events and phenomena to be studied using data obtained from satellite measurements. The derivation of Type II solar radio propagation speeds from European and American observing sites will be concluded. The results will be used to initiate an analytical study of solar flares, Type II radio speeds, and the onset of geomagnetic disturbances that disrupt operations in space. Studies of solar and interplanetary magnetic field relationships will be extended to include solar wind parameters. Major efforts will be placed on advancing our understanding of the energy transfer processes throughout the solar terrestrial system toward the goal of a predictive model of thermospheric dynamics including changes in satellite drag, thermospheric winds, and density enhancement that can affect large satellite operations and satellite orbits. Joule heating statistical models and satellite data will provide key inputs into global thermospheric circulation models. Magnetosphere-ionosphere substorm models will be coupled more closely to thermospheric phenomena. Analysis of satellite data sets will provide the validation of the modeling efforts. Analytical studies of active experiments and of experimental beam-plasma interactions will be completed. Satellite and rocket based experiments will be initiated for modification and perturbation of space plasma processes. Work will continue on defining the spectral, spatial, and temporal signature of the celestial infrared background to permit effective

discrimination techniques and methods of detecting space objects against this natural background.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Work will be performed on Solar-Terrestrial Physics, aiming toward a complete understanding of the generation of solar storms, their propagation to the Earth and their impact on the magnetosphere. The goal is to develop a predictive capability for solar storm activity. Special areas of concentrated effort will be in: hydromagnetic waves in the magnetosphere; and the observation, identification and analysis of global solar oscillations. A study of solar activity, including the use of a high resolution vector magnetograph for observation and measurement of solar activity which causes major disturbances on Air Force communications systems, will continue. The results will be used to improve a solar atmospheric model which is designed to discriminate among the various possibilities for energy transport during flares, and to determine the underlying causes for the energetic ejections that degrade command, control, communications and intelligence systems. Such knowledge will permit the development of a predictive capability for the occurrence of solar activity. A theoretical study of the effects of artificially modified geomagnetic regions on communication systems will be continued. A study will be initiated to investigate and model the total energy input from the magnetosphere to the ionosphere. The model will be verified using measurements of electric and magnetic fields obtained from the Defense Meteorological Satellite program. The model will provide improved data which permits the accurate calculation of satellite drag. This information is needed for satellite tracking and orbital decay predictions. A study will begin to investigate the interaction of man-made charged particle beams with plasmas found in the ionosphere and magnetosphere. The results will be important to the understanding of how directed energy can be transmitted over long distances and to the development of innovative techniques for low frequency communication systems. Studies will continue to define the spectral, spatial and temporal signatures of the celestial infrared background radiation. This work will permit the development of effective techniques for target discrimination and tracking. A more detailed knowledge of the infrared background will allow the informed selection of the stressing backgrounds for space surveillance systems.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Work will be completed on the Infrared Space Surveillance and Background Radiation Program to define the spectral, spatial and temporal emissions from both faint and intense infrared sources, solar system objects, such as satellites and asteroids, and to model celestial sources at high resolution and high sensitivity. This infrared data is required to develop discrimination techniques and to detect objects in space against the celestial infrared background. Work will continue on the generation and propagation of hydromagnetic waves in the Earth's magnetosphere in order to determine if the properties of these magnetic perturbations can be applied as a diagnostic tool for assessing and predicting the particle and field conditions in the near-Earth environment. A program in solar activity will begin to uncover the basis of the solar activity cycle. Disturbances on the Sun propagate to Earth and affect the environment in and through which the USAF communication and surveillance systems operate.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not applicable.

Program Element: 61102F
DOD Mission Area: 510 - Defense Research

Title: Defense Research Sciences
Budget Activity 1 -Technology Base

19. (U) PROJECT MORE THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2312, Biological and Medical Sciences

A. (U) Project Description: This research project provides knowledge needed to protect Air Force personnel and enable them to perform effectively in hostile environments. The project consists of three major research programs: (1) Biological effects of radiofrequency radiation and toxic chemicals are being studied to assess hazards to personnel and the environment and to devise protective measures; (2) research in mechanisms of neuroregulation is being conducted to understand the biological bases of human performance and thus provide ways to enhance performance by, for example, reducing the effects of fatigue, jet-leg and diurnal rhythms; and (3) research to develop computer architectures modeled after neuronal systems is aimed at providing powerful new approaches to machine intelligence.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: (1) The effects of different concentrations of toluene on living cells were determined. The Air Force uses toluene and similar aromatic compounds as components of jet fuels and as solvents for degreasing. There has been concern that personnel exposed to toluene may suffer from delayed effects on health. This research revealed that, while high concentrations of toluene kill cells, the effects of lower concentrations are selective and temporary. The cell component found to be most sensitive to toluene was the plasma membrane, the outer wall of cells. Low concentrations of toluene caused morphological changes in the membrane and inhibited membrane enzymes, however, these effects rapidly disappeared when toluene was removed. This research will help establish appropriate safety procedures and exposure standards for workers. (2) Ways were found to manipulate circadian pacemakers, the biological clocks that control the body's daily rhythm of activity, sleeping and waking and physiological functions. The pacemakers are neural circuits and recent research has revealed some of the neurotransmitters with which neurons in these circuits transmit information to other neurons. The activity of these neurotransmitters can be manipulated with drugs or changes in diet, and these manipulations were shown to reset the period of the neural pacemakers. This research offers the possibility of developing safe drugs to diminish the effects of sleep disruption, fatigue, stress, and jet-leg on the performance of pilots and other personnel.

(2) (U) FY 1987 Program: The program of radiation research will continue. Completion of a theoretical study of radiation absorption mechanisms in living cells will guide future experimental studies to determine whether there are non-thermal associated with radiofrequency radiation. The toxicology program will continue, with the ultimate goal of being able to predict what types of toxic hazards will be encountered when a new chemical entity is introduced in Air Force operations. A new thrust will examine the ecological pertubations caused by chemicals released into the environment by Air Force operations. For instance, military bases have large amounts of toxic wastes stored underground which may leak out into the environment, and Air Force space shuttle missions may contribute to acid rain production. The new thrust will examine the ways in which ecological systems are altered by exposure to toxic chemicals. The aim is to devise better ways of assessing long-range environmental impact so that Air Force operations can be planned to minimize adverse effects. The neurobiology program will continue, with growing emphasis on how neural regulation determines aspects of performance such as arousal, attention, and resilience to stress.

Research on neural mechanisms of learning will continue. This program will also include studies of how computer architectures may be modelled after neural networks. In contrast to most research in artificial intelligence, which works on software in conventional computer architectures, this approach examines how the features of neural circuitry allow living organisms great capacity for parallel processing of information and for learning.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The FY 1987 program will continue as described above, with the following addition: A joint initiative in neural and computer architectures for knowledge based systems will involve the directorates of electronics, life sciences, and mathematics. Conventional computer architectures limit attempts to develop sophisticated artificial intelligence. Needed are architectures that allow extensive parallel processing rather than sequential operations, learning and self-programming by the machine, and tolerance to component failures. This initiative will support research on such nonconventional architectures. This research will include study of neural systems, which have the desired properties, and the information-processing mechanisms of humans as a model for intelligent machines.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: A new thrust is planned for research on subclinical cardiovascular disease in aircrews. Aircrew personnel are often grounded for subclinical cardiovascular irregularities, however the functional significance of these irregularities is poorly understood. In some cases aircrew personnel might be able to perform limited or even unlimited flying duties in spite of the irregularity. The USAF School of Aerospace Medicine, in collaboration with an academic medical center not yet determined, will start research to develop better ways to detect subclinical cardiovascular disease and to assess its functional significance. The toxicology program will continue to emphasize research on better ways to predict hazards from chemicals introduced into Air Force operations. The program will be extended to support research at the USAF Environmental Service Laboratory on developing bacteria to degrade toxic wastes. The neurobiology program will continue its emphasis on neural mechanisms that determine the capabilities and limits of human performance. It will also continue research in collaboration with other directorates to develop novel approaches to artificial intelligence based on the study of neural networks.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not applicable.

20. (U) PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2313, Human Resources

A. (U) Project Description: This program provides the knowledge required to ensure that Air Force personnel can operate, maintain, and manage complex equipment systems in demanding environments. The major objectives are to improve selection of personnel for appropriate jobs on the basis of measured mental abilities and sensory-motor skills, designing equipment to match human information processing characteristics optimally, and monitoring human workload and performance.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: (1) A new theory has been proposed for the early stages of human visual processing. Scientists in many disciplines are interested in early processing because it underlies the human ability to visually recognize everyday objects and because it can help the development of computer vision. Early processing includes the many transformations of retinal images occurring in sensory pathways to the brain and in the brain itself. This new theory is important because, among other features, it explains how early processing could generate perceived contours that define boundaries among objects, an essential step preceding recognition of the objects. Some contours are easily defined, for example, large differences in brightness or color. Many important contours in an image, however, are more complex and cannot be described this way. The theory describes two mechanisms in early sensory processing that may explain the human ability to perceive simple and complex contours. It includes a mathematical model of neural circuits that can perform the necessary computations on an image. This research is stimulating interaction among neuroscientists, perceptual psychologists, and computer scientists concerned with visual processing and developing machines capable of recognizing images. (2) An innovative method was developed to record and analyze the electrical activity of the human brain. Recordings are made from as many as 60 electrodes around the scalp as subjects perform visual and motor tasks. A long-standing problem, determining the exact region of the brain probed by the scalp electrodes, was solved by making nuclear magnetic resonance scans of each subject. A new mathematical algorithm was developed to analyze the data from the electrodes. The first results suggest, somewhat surprisingly, that for subjects to perform even quite simple tasks requires coordinated activity of widespread regions of the brain. This research may lead to methods of monitoring human performance of tasks such as flying combat missions and ways to couple to expert machine systems that will assist the pilot.

(2) (U) FY 1987 Program: An initiative in Cognitive Aspects of Human Performance will start. Air Force equipment systems have become so complex and the flow of information in tactical situations so rapid that the operator's ability to process information, make appropriate decisions, and act quickly is overwhelmed. Better ways to organize and present information from the equipment display to the human operator are urgently needed. One element of this program will examine the ways in which skilled individuals, such as pilots, process information and make decisions under heavy workload. Mechanisms of attention, multiple-task performance, and memory will be studied. Another element of this new program will examine individual differences in these mechanisms to develop better tests of learning abilities. Air Force recruits are assigned to military occupational specialties partly on the basis of their scores on aptitude tests. Existing tests have limited power to predict aptitude for real-world jobs, but research in this field has not advanced dramatically until recently. This situation is now changing because of recent advances in our understanding of cognitive functions and through the use of computer terminals to allow adaptive testing of individuals rather than traditional paper and pencil tests. This initiative will support research collaborations between leading university scientists and the Air Force Human Resources Laboratory, at which a major computer facility for aptitude testing has been developed. The new program in auditory pattern recognition will reach full size, continuing its emphasis on the mechanisms by which humans recognize complex auditory patterns. The vision research effort will continue to study the mechanisms by which humans recognize objects, determine position and velocity of moving objects, and guide their own movements through the environment. Besides improving our understanding of human performance, these studies will open up ways to design machines capable of recognizing images and responding to speech.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The initiative in Cognitive Aspects of Human Performance will reach full size. The Armstrong Aeromedical Research Laboratory and the Air Force Human Resources Laboratory will begin collaborative research as part of this initiative, examining how humans allocate mental resources to perform complex tasks in which several things must be accomplished in the same time frame. The extramural part of the program will be expanded to examine fundamental aspects of thinking, problem-solving, judgment, and decision-making in conditions of uncertainty. The vision research and auditory research programs will continue to study how sensory mechanisms allow humans to extract and analyze information from the environment and use that information to guide their actions.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The vision and auditory research programs will be expanded to include neurophysiological research approaches in addition to the psychophysical studies currently supported. Although the sensory nervous system has been the subject of much research, most of that research has focused on the early stages of visual information processing, because these stages have been the easiest to study. It is now possible to study later stages of visual processing, stages involved in the more complex aspects of perception such as recognition of objects. This is possible because of several advances: 1) more sophisticated techniques for recording the electrical activity of neurons, 2) better understanding of the organization of the sensory nervous system and 3) development of theories of information processing that can be tested by combining of neurophysiological and behavioral approaches to be far more powerful than either alone. The cognitive program will continue, with strong commitment to both Air Force laboratory and university research.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not Applicable.

21. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 61103F
DOD Mission Area: 510 - Defense Research

Title: University Research Initiative
Budget Activity: 1 - Technology Base

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT	5,824	8,543	19,536	24,593	Continuing	N/A
3396 University Research Initiative	5,824	8,543	19,536	24,593	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Science and Technology program began in FY 1986. It provides funding for selected emerging technologies of special importance to the Air Force by providing additional support to universities. Interdisciplinary research initiatives, instrumentation, graduate fellowships and university programs with Air Force laboratories will be supported in designated areas.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	5,824	12,530	25,000	N/A	0	43,354

EXPLANATION: (U) The FY 1987 change is due to a Congressional reduction. The FY 1988 change is due to a general reduction in Air Force Total Obligation Authority. The change in total program estimated cost is due to an OSD directed continuation of the program.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: The Army, Navy, and the Defense Advanced Research Projects Agency have started similar programs. Overall coordination for these programs is in the Office of the Deputy Under Secretary of Defense (Research and Advanced Technology). Individual efforts are coordinated directly between the awarding agencies. Some research efforts are jointly funded with program element 61103D.

6. (U) WORK PERFORMED BY: Funding under this program element is limited to contracts and grants to U.S. academic institutions. The top five institutions in FY 1986 were Johns Hopkins University, Baltimore MD; Purdue University, Lafayette IN; University of Alaska, Fairbanks, AK; Massachussetts Institute of Technology, Cambridge, MA; Southeastern Center for Electrical Engineering Education, St Cloud, FL. There were seventeen additional institutions with a total of $682 thousand in contracts.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3396, University Research Initiative

A. (U) Project Description: The program provides funding for instrumentation, graduate fellowships, and interdisciplinary research initiatives at U.S. universities in selected emerging technologiee of intereet to the Air Force.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Graduate fellowships are being initiated in the academic disciplines which support high technology areas of particular interest to the Air Force: electronice, thermionics, propulsion, composite materials, and artificial intelligence. However, because this was a new etart in FY 1986 and initial efforts start late in the fiscal year there are no specific scientific accomplishments yet reportable.

(2) (U) FY 1987 Program: Graduate fellowships and equipment support to universities will continue. In addition, academic programs will be established during FY 1987 and FY 1988 which will provide a long term research capability in mathematics and computer concepts, ultra-submicron electronics, behavioral sciences, high performance materials, space science, fluid dynamics, and optics.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The fellowship programs begun in FY 1986 and FY 1987 to provide fellowships for faculty and students to work at Air Force laboratories, to provide expertise in specific areas such as microwave tubes and propulsion, and to establish excellence in artificial intelligence at certain universities will continue to be supported. Other specific academic programs to be pursued are analysis, modeling and simulation, technologies for automation, submicron structures, electro-optic systems and signals analysis, high performance materials, fluid dynamics syetems, human performance factors, environmental science and technology, and propulsion technology.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The program will continue funding instrumentation, graduate fellowships, and research at U.S. universitiss in support of emerging technologies of interest to the Air Force.

(5) (U) Program to Completion: Thie is a continuing program.

C. (U) Major Milestones: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62101F   Title: Geophysics
DOD Mission Area: 522 - Environmental and Life Sciences (ED)   Budget Activity: 1 - Technology Base

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	36,088	38,259	39,523	42,436	Continuing	N/A
06GL	Laboratory Operations	22,143	22,506	23,368	23,932	Continuing	N/A
3054	Infrared Target and Background Signatures	1,745	3,059	3,053	3,288	Continuing	N/A
4643	Ionospheric Specification	2,020	2,166	2,432	2,999	Continuing	N/A
6670	Atmospheric Science and Technology	1,587	1,357	2,432	1,813	Continuing	N/A
7600	Terrestrial Geophysics	903	1,080	806	921	Continuing	N/A
7601	Space Effects on Air Force Systems	4,392	4,342	4,182	5,862	Continuing	N/A
7659	Aerospace Systems Technology	701	539	205	203	Continuing	N/A
7670	Optical/Infrared Properties of the Environment	2,597	3,210	3,045	3,418	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The geophysical environment has the capacity to alter the performance of Air Force systems and operations, and it seldom enhances or eases their performance. Functions which can be affected significantly or nullified completely by adverse or unexpected geophysical conditions are missile guidance, air launch and recovery, target identification, space vehicle tracking, satellite surveillance and communications. This science and technology program element provides the technology to understand the environment as an integral and interacting part of the systems themselves and enables Air Force systems planners and users to help mitigate environmental effects and, in some cases, to exploit them. It also provides for the management and support of the Air Force Geophysics Laboratory, Hanscom AFB MA.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	39,429	40,625	42,128	N/A	Continuing	N/A

EXPLANATION: (U) The FY 86 Actual program reflects a reduced level resulting from Gramm-Rudman-Hollings, inflation reductions, and reprogramming for the Small Business Innovative Research Program. The FY 1987 reduction reflects Congressional action. The FY 1988 reduction reflects the decrease in overall Air Force Total Obligation Authority.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Military Construction: Funds	0	0	0	530	0	530

5. (U) RELATED ACTIVITIES: This program benefits greatly from research in PE 61102F, Defense Research Sciences. Major beneficiaries of the technology developed in this program are PE 63410F, Space Systems Environmental Interactions Technology; PE 63424F, Cruise Missile Surveillance Technology; PE 63438F, Satellite Systems Survivability; PE 63707F, Weather Systems (Advanced Development); PE 12417F, Over-The-Horizon Radar System; PE 64707F, Weather Systems (Engineering Development); PE 63402F, Space Test Program; PE 12431F, Defense Support Program; and PE 35160F, Defense Meteorological Satellite Program. Programs in the broad area of geophysics are conducted by the Army and Navy and nonmilitary federal agencies such as the National Oceanic and Atmospheric Administration and National Aeronautics and Space Administration. When applicable to Air Force requirements, information gathered by others is used in the Air Force program. In addition to such complementary programs, joint or coordinated programs are conducted with other agencies when mutual interests exist. The work within this program element is coordinated (1) at the annual tri-service briefings to the Office of the Under Secretary of Defense for Research and Engineering during the Science and Technology Tri-service review, (2) through the National Aeronautics and Space Administration/Air Force Systems Command Space Technology Interdependency Group which meets annually, (3) with National Oceanic and Atmospheric Administration and other federal agencies engaged in geophysical sciences through committees of the Federal Coordinating Council for Science, Engineering and Technology and the Federal Coordinator for Meteorological Services and Supporting Research, and (4) through working groups set up by the Air Force Geophysics Laboratory, such as in satellite meteorology. Examples of joint or coordinated programs are: Next Generation Weather Radar, a Department of Defense, Department of Transportation, and Department of Commerce program to develop a national doppler weather radar network for reliable severe weather detection and warning; Spacecraft Charging and Spacecraft Environmental interactions, a joint program with the National Aeronautics and Space Administration to control undesired electrical charge buildups on satellites, and to develop environmental specifications for future large space structures; Atmospheric Transmission, a coordinated program with the Army and Navy to develop the capability and the computer codes to predict and overcome the obscuring effect of the atmosphere on visual, infrared and millimeter wave sensors employed in tactical and strategic systems; Intercontinental Ballistic Missile Accuracy, a coordinated program with the Defense Mapping Agency to develop techniques and geophysical instrumentation to improve missile targeting accuracy; Nuclear Weapons Effects, a program with the Defense Nuclear Agency to model the nuclear-disturbed environment; and the seismology portion of the Defense Advanced Research Projects Agency Nuclear Test Monitoring Program.

6. (U) WORK PERFORMED BY: Work performed under this line item is conducted and managed by the Air Force Geophysics Laboratory, Hanscom AFB, MA. Five of the major contractors were: Emmanuel College, Boston, MA (7601); Wentworth Institute, Boston, MA (7670); Utah State University, Logan, UT (3054); Systems and Applied Sciences, Vienna, VA (6670);

Boston College, Chestnut Hill, MA (4643). In addition, there were approximately 85 other contractors doing work totaling $18.0 Million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 3054, Infrared Target and Background Signatures. The Air Force is increasing reliance upon infrared sensors for surveillance, warning, and weapon guidance. This project characterizes the infrared signatures of both natural (aurora, airglow, down-viewing, and earth's horizon-viewing) and nuclear earth/atmospheric backgrounds and military targets of interest which operate therein. Infrared backgrounds and targets are characterized through the use of field data obtained using rockets, aircraft, balloons and the space shuttle as measurement platforms. These data are analyzed, compared against theoretical and laboratory measurements, and then integrated into models for infrared surveillance systems application (design, development and operations). During FY 1986 the spectral infrared interferometer telescope was successfully launched into a strong aurora to obtain measurements at the earth's horizon. Measurement programs were conducted in support of field testing of the infrared search and track system being developed by the Aeronautical Systems Division. Field testing and evaluation of the far acquisition, low clutter optical nutation instrument which removes the background clutter in the focal plane of the sensor was completed. The installation and testing of the Schottky infrared sensor in the Air Force Geophysics Laboratory Flying Infrared Laboratory was completed. The sensor will be used to improve the quality of the infrared target signature data base. In FY 1987, a high resolution infrared auroral measurement rocket experiment will be launched into a high intensity aurora to identify auroral emitters produced under intense auroral conditions which simulate a nuclear detonation. A ground-based demonstration of a fast acquisition spectral transient interferometer, to measure random source transient will be conducted. This new random source interferometer acquires spectra from an infrared focal plane array rather than sampling over a period of time. When coupled with the low clutter optical nutation instrument, the fast acquisition spectral transient interferometer should allow an observer to see 80-100 decibels into the background clutter, allowing lightning and laser pulses to be spectrally measurable. The acquisition of an airborne stabilized cooled optical telescope will be initiated. The optical telescope will increase our capability to detect dim and low observable targets over long ranges from an inflight platform. In FY 1988, the development of the excited electron deposition experiment to simulate and measure the infrared radiative effects of high altitude nuclear bursts will be completed and made ready for launch. In FY 1989, the construction phase for the airborne stablized cooled optical telescope will be implemented. Field measurements will be conducted with the new concept fast acquisition spectral transient interferometer. Work will continue on the development of a Supersensitive Spectral/Spatial Sensor. Infrared clutter models for the Atmospheric Radiance Code and the Auroral Atmospheric Radiance Code will be delivered to Space Division.

B. (U) Project: 4643, Ionospheric Specification. The Air Force is increasingly involved with systems operating in the ionosphere. This project develops the capability to predict, mitigate and exploit the effects of the ionosphere on Air Force systems. Specific efforts include: (1) measuring the effect of D Region conductivity on Extremely Low Frequency/Very Low Frequency radio propagation, (2) specifying and predicting polar cap ionospheric irregularities that disturb high latitude communications and radars, (3) developing techniques to predict ionospheric characteristics that affect the performance of communication and surveillance systems such as Over-The-Horizon radar and survivable

meteor scatter communications and (4) developing instrumentation and techniques for the Defense Meteorological Satellite Program to measure remotely the ionospheric electron density on a global basis. During FY 1986, a Total Electron Content computer model was developed and Air Weather Service was provided with the specifications for a real-time ionospheric monitoring system. A monthly program to measure the polar/auroral ionosphere structure and structured plasma transport across the polar cap into the SPACETRACK and Over-The-Horizon radar relevant regions was conducted to develop the data base for systems needing short-term prediction capability. Two balloon flights of a mass spectrometer were conducted to measure stratospheric ion composition from 30 to 40 kilometer altitude. These data will be used to develop models to predict the propagation of long wavelength radio waves during severely disturbed conditions. In FY 1987, a major rocket/aircraft ground based program in Greenland will attempt to solve the high latitude ionospheric circulation problem of medium and large scale ionospheric structures generated at high latitudes being transported by polar cap electric fields into coverage regions of surveillance radars. Results will be used to enhance the operational capability of high latitude missile warning radars. Computer codes to calculate the electron density profile from optical and other remote passive measurements will be developed for use on Air Force weather satellites. Verification of the relationship between ultraviolet radiation and electron density will be initiated using the ultraviolet airglow measurements. Theoretical and experimental studies of ionospheric heating effects will be conducted. In FY 1988, as the solar activity and the associated high latitude disturbances increase in frequency, a comparison of the survivability of Very High Frequency meteor scatter and High Frequency conventional radio will be conducted. The phase scintillation data base measurements program at high latitude will be completed and summarized for use in systems outage predictions. Ionospheric heating experiments will be conducted to test the feasibility of creating artificial ionospheric mirrors. In FY 1989, a semiempirical model to predict communication outages due to phase scintillations on a global basis in near-real-time will be completed. A technique for oblique remote sensing of the electron density profile will be developed for use in support of the Over-The-Horizon radar and recommendations for operational quenchants to reduce missile and aircraft engine radar cross section will be made based on analyses of field results.

C. (U) Project: 6670, Atmospheric Science & Technology. The Air Force requires new techniques to satisfy requirements for its ever expanding mission in support of emerging technologies to support new communications, surveillance, and acquisition systems which are impacted by the atmosphere. This project develops capabilities for measuring, modeling and predicting atmospheric properties which impact the Air Force mission. The current atmospheric global models are not capable of providing sufficient resolution for many operational missions. Under this project smaller scale models are developed to provide the required detail. During FY 1986, a two month weather attenuation measurement program was conducted that simultaneously obtained Extremely High Frequency attenuation data and detailed microphysical data on clouds, rain, and snow in the melting layer. This program acquired the data base needed for developing a frequency dependent, cloud, and precipitation electro-optical attenuation model. The meteorological and radio data collected over the past years were used in conjunction with the radio wave propagation models to develop techniques for diagnosing periods of enhanced or degraded performance of Air Force communication links. Ground based refractive measurements were made and evaluated as a predictor of enhanced radio wave propagation of forward scattered radio signals. A diffusion model using hill and mountain topography as input was developed by combining the Air Force Geophysics Laboratory Diffusion model with the Army's Atmospheric Sciences Laboratory wind-flow model. New Air Force reference atmospheres for 0-200 kilometers were published and an evaluation of the rainfall rate estimates from satellite observations was initiated. During FY 1987 a high resolution rainrate data base will be

established. Shuttle cloud photographs will be used to model the distribution of cloud size and spacing needed to determine cloud free line-of-sights for laser communication and the infrared search and track system used to detect warm targets from above. The microphysics of the cloud model will be tested against the weather attenuation data sets. The use of microwave imagery information for mapping meteorological parameters such as rainrate, ocean surface wind speed, and soil moisture will be evaluated. In addition, techniques for incorporating microwave imagery data into the cloud analyses program at the Air Force Global Weather Central will be developed. During FY 1988, a rainrate duration model and the operational atmospheric dispersion model validation will be completed. The validation of the cloud simulation model will also be completed. A technique development effort to predict Extremely High Frequency attenuation using radar and satellite data will be initiated. Efforts to develop advanced techniques for measuring and modeling atmosphere density will be intensified in FY 1988. This capability is essential to support transatmospheric and aerobrake vehicles, as well as stationkeeping of low orbiting platforms and improved reentry predictions. In FY 1989, the regional numerical weather prediction model using satellite data will be completed. A global model to predict satellite drag and three mesoscale models (cloud-scale, limited area and theater scale) will be developed for use in the National Storm Central program.

D. (U) Project: 7600, Terrestrial Geophysics. This project measures and models the earth's geometry, gravity field, dynamics and motions to support Air Force strategic systems. Improved resolution and accuracy of global and launch region gravity models will be pursued through measurement and data analyses techniques. Earth motion properties affecting Space Division's Space Transportation System, Ballistic Missile Office's (BMO) Peacekeeper, Air Force Logistics Command's jet engine test facilities, and Tactical and Strategic Air Command operations will be defined through field measurements and computer modeling. In FY 1986, a vibroacoustic system was installed at Vandenberg AFB, CA, to monitor Shuttle and Peacekeeper launches. The observed acoustic environment will be compared with the model forecasts to establish the validity of the forecasting scheme. The balloon borne gravity data obtained from test flights at Holloman AFB, NM, were analyzed and the first significant high altitude gravity data obtained. The results of the Miniature Interferometric Terminals for Earth Surveying initial baseline positioning system were published. In FY 1987, the development of methods for assessing the complete motion environment of possible Peacekeeper sites will be completed. In addition, the ground and airborne testing of the gravity gradiometer system which measures changes in the earth's gravity will be initiated. Plans for the operational launch area gradiometer surveys will be completed. In FY 1988 gravity gradiometer surveys will be initiated in the launch regions. The Ballistic Missile Office Deep Basing model studies of survivable basing of intercontinental ballistics missiles will be completed. In FY 1989, the prototype cryogenic gravity gradiometer will be tested before transitioning to the Space Division and the Defense Mapping Agency. The high-strain motion forecasting procedure will be delivered to the Ballistic Missile Office, and development of the geodetic reference frameworks for the Defense Mapping Agency will continue.

E. (U) Project: 7601, Space Effects on Air Force Systems. This project defines the impact of the space environment on Air Force systems and develops techniques for predicting, mitigating and exploiting the effects of the space environment which degrade Air Force systems. Of particular interest to Air Force operations in space are the earth's radiation belts; high latitude particle, current and field effects; environmentally induced adverse effects on large space systems as well as the problem of spacecraft contamination in the form of chemical, particulate and optical contaminants which can degrade spaceborne sensing systems and represent a target for easy detection. In FY 1986 the final

report on the charged particle beam experiments on the Beam Emission Rocket Test I rocket was published and an auroral zone boundary computer code delivered to Air Force Global Weather Central. The charging and high energy potential on large spacecraft in Aurorae Regions computer code was updated to include modeling using the Shuttle Auroral Contamination Sensors data as well as all the available shuttle particulate data. A study of electrostatic charging conditions on astronauts in the shuttle wake was initiated. The Combined Release and Radiation Effects Satellite space radiation satellite sensors and microelectronics experiments were completed on schedule. In FY 1987 the development of environmental sensors to measure atmospheric pressure, charged particle density, and electric and magnetic fields in the vicinity of large space structures will be tested. The propagation of electron beams between the hemispheres will be determined from the Echo 7 rocket launch. In FY 1988/1989 the environmental diagnostic sensors will be delivered. The subsequent space flight will quantify space environment interactions under disturbed conditions and provide design criteria for large space structures. A modeling effort of the upper atmosphere where the earth's magnetic field traps charged particles (magnetosphere) will be initiated. This effort includes specific models describing the coupling between the magnetosphere and the region of the earth's atmosphere containing free electrically charged particles (ionosphere). These two models will provide a capability to predict the charged particle and particles environment of Air Force satellites and thus the ability to predict and mitigate spacecraft anomalies. Particle, charged particles and field detectors developed for operational spacecraft will supply data needed to validate models required for space operations.

F. (U) Project: 7659, Aerospace Systems Technology. This project improves our capability in the spacecraft, balloon, and sounding rocket payload systems used as experiment carriers by Air Force Geophysics Laboratory and DOD. The work is focused on applying modern technology, particularly microelectronics, in developing experimental sensor platforms. In FY 1986, the tethered balloon antenna system was demonstrated successfully in a Navy communication test. This system uses the balloon's 3,000 ft tether as an antenna allowing Very Low Frequency communications among strategic forces. The High Altitude Recovery Program (HARP) was tested successfully. This program provides capability of retrieving high cost sensors from higher altitude rockets when launched over water. In FY 1987 development testing will be completed on a prototype liquid helium cooler for use with inexpensive Get-Away-Special infrared experiments to be flown on the shuttle. A simplified balloon navigation system using the Global Positioning Satellite system will be designed. In FY 1988, final testing will be conducted on a system which adapts a commercial laser disk recorder for use in recording high-rate, pulse-code-modulated telemetry data. This system will provide an inexpensive method of increasing the accuracy of recorded digital telemetry data. In FY 1989, testing of the balloon navigation system will be completed and the system made available for precise balloon tracking for efforts such as the Defense Mapping Agency gravity gradiometer program and the Airborne Low Frequency Atmospheric Noise data base program.

G. (U) Project: 7670, Optical/Infrared Properties of the Environment. This project develops the data base and technology for designing and operating infrared/optical surveillance and laser weapon systems under real-world conditions. This includes the effect and limitations of propagation through the atmosphere and of atmospheric and space backgrounds on the range, accuracy and lethality of these systems. In FY 1986, the Infrared Zodiacal Light model was extended to incorporate the latest results from the National Aeronautics and Space Administration Infrared Astronomical Satellite. The fixed lidar (light plus radar) facility at the Air Force Geophysics Laboratory developed techniques for measuring atmospheric density and temperature at very high altitudes and moisture content in the

troposphere. The originel balloon-borne lidar system was modified to eccommodate a specially designed hybrid carbon dioxide laser for particulate scattering measurements. Development of the Visual Photometric Experiment was completed. This experiment usee a four color visuel photometer and low light level television cameras to messure the diffuse beckground from e Shuttle Get-Awey-Special platform. Transmission measurements and modeling efforts of codes for long slant path (greater then 50 kilometers) transmission predictions were initieted. In FY 1987, the trensmission code for very long peth lengths will be completed. The design study for the lidar sounder for the Defense Meteorological Setellite Progrem (DMSP) Block 5D-2 spacecraft will be completed. This will include en engineering level design for the lidar instrumentation for incorporation as an experimental sensor on an operational DMSP mission. The balloon-borne lidar with the hybrid carbon dioxide laser will be flown to obtain particulete scattering date. In FY 1988 a doppler lidar will be flown on a balloon to determine feasibility of obtsining wind information. A revised Celestial and Zodiacal Light model will be published. An experiment will be flown on a dedicated rocket payload to investigete the galactic plene et a higher resolution than currently available. This experiment will obtein measurement in the long wevelength infrared spectral regions. In FY 1989, the Laser Propagation Model and Turbulence Forecest Model for ground besed lesers will be completed. The Long Wave Infrared Celestial Backgrounds Model will be expanded. Test end evaluetion of doppler wind sensing and signal processing techniques for Defense Meteorologicel Satellite Progrem Block 6 will continue.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 06GL, Laboretory Operations

A. (U) Project Description: This project provides for manegement, support, and operation of the Air Force Geophysics Laboratory, Hanscom AFB, MA. It provides for the pay and related costs of civilian scientists, engineers and support personnel; trensportetion of equipment, rents, communications and utilities costs, duplication end reproduction services and procurement of supplies, equipment end contractor support services for maintenance and modificetion of facilities. The Air Force Geophysics Laboratory performs reseerch end exploratory development in the geophysicel sciences--geodesy, gravity, meteorology, opticel physics, ionospheric physics, upper atmosphere physics, infrared backgrounds and space physics--in support of immediate or potential needs of Air Force operationel systems. This project supports and complements ell other projects in this program element.

B. (U) Program Accomplishmente and Future Efforts: Not Applicable.

C. (U) Major Milestones: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62102F
DOD Mission Area: 523 - Engineering Technology (ED)

Title: Materials
Budget Activity: 1 - Technology Base

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		52,794	50,948	62,676	63,064	Continuing	N/A
06ML	Laboratory Operations	14,485	15,403	16,076	16,441	Continuing	N/A
2417	Thermal Protection Materials and Structures	4,592	4,005	4,698	5,079	Continuing	N/A
2418	Metallic Structural Materials	12,622	10,168	12,013	13,249	Continuing	N/A
2419	Nonmetallic Structural Materials	5,735	5,910	9,034	7,423	Continuing	N/A
2420	Aerospace Propulsion Materials	3,095	3,427	5,705	5,470	Continuing	N/A
2421	Fluids, Lubricants and Elastomeric Materials	2,729	3,301	3,875	4,463	Continuing	N/A
2422	Protective Coatings and Materials	4,537	3,720	4,128	4,689	Continuing	N/A
2423	Electromagnetic Windows and Electronic Materials	4,999	5,014	7,147	6,250	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Science and Technology program contains the entire Air Force Exploratory Development program in materials. It develops new materials which are required to meet the increased performance, reliability and survivability demands of current and future aerospace systems. The needs of Air Force aircraft, spacecraft and missiles are specialized and unique and cannot be satisfied solely by research and development programs sponsored in the private sector. The program also provides management and operational support for the Materials Laboratory, Wright-Patterson Air Force Base, OH, as the Air Force agency concerned with all aspects of materials research, development and manufacturing technology.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	53,235	57,478	60,150	N/A	Continuing	N/A

EXPLANATION: (U) Fiscal Year (FY) 1987 program reduction is due to Congressional action. Increases in the FY 1988 funding level are to enhance developments with revolutionary potential for weapon system applications in the areas of High Temperature Materials for Turbine Engines; Ultra-Lightweight Aircraft Materials/Structures; IR Detectors and Semiconductor Amplifiers; and Optical Materials for High Speed Signal Processing and Optical System Survivability.

4. (U) OTHER APPROPRIATION FUNDS: Not applicable.

5. (U) RELATED ACTIVITIES: All three military services, the Defense Advanced Research Projects Agency, the National Aeronautics and Space Administration, the Department of Energy, and industry through the Independent Research and Development program, carry out research and development programs in materials technology specifically related to their requirements. Coordination is provided by the exchange of planning documents, joint agency technical planning committees and activities such as the Department of Defense Metal-Matrix Composite Steering Committee, the Joint Directors of Laboratories Advanced Materials Panel, and the Tri-Service Laser Hardened Materials and Structures Group. These joint planning meetings and materials coordination activities highlight the specialized materiel requirements of each organization and are determining factors in the formulation of complementary, nonredundant materials research and development programs. Interface with industry and the technical community is reinforced by active participation in academic and professional organizations and societies. This program element receives specific input from PE 61102F, Defense Research Sciences. This program element provides technology for further development to other program elements such as PE 62203F, Aerospace Propulsion; PE 63211F, Aerospace Structures and Materials; PE 63202F, Aircraft Propulsion Subsystems Integration; PE 63216F, Aerospace Propulsion and Power Technology; and PE 78011F, Manufacturing Technology.

6. (U) WORK PERFORMED BY: The Materials Laboratory of the Wright Aeronautical Laboratories, Wright-Patterson AFB, OH, is the organization responsible for the management of the program. The top five contractors in FY 1986 were: University of Dayton, Dayton, OH (2417, 2418, 2419, 2420, 2421, 2422, 2423); General Electric Company, Cincinnati, OH (2417-2420, and 2423); Systems Research Laboratories, Dayton, OH (2417-2419 and 2422); United Technologies, West Palm Beach, FL (2418 and 2420); and Rockwell International Corporation, Thousand Oaks, CA (2418, 2419, 2422, 2423); representing a contract value of $58,740,283. There are 70 additional contractors and the total contract value for contracts active in FY 1986 was $71,107,401.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 2417, Thermal Protection Materials and Structures. Provides new materials and processes for thermal protection of Air Force systems and components exposed to intense heat, mechanical stresses, and erosive environments. High performance materials technology is emphasized for future uses on military gas turbine engines, solid rocket and space engine propulsion systems, strategic reentry and penetration systems such as maneuverable re-entry vehicles (MaRV) and the Boost Glide Vehicle (BGV), space structures and high Mach number aerodynamic vehicles. Emphasis is on improving the performance of carbon fiber reinforced carbon matrix composite materials. These materials are the most promising available for maintaining acceptable strength at very high temperatures. High temperature dielectric (nonconductive) materials such as nitride/silica based materials are being developed for reentry system antenna windows. FY 1986 accomplishments include: development of thermally stable carbon-carbon composite substrates with inherent oxidation resistance (oxidation is the most single serious limitation of carbon-carbon for long term, structural use in high temperature environments); development of a protective layer coated carbon-carbon combustor for the F-107 cruise missile engines; development of a method for producing low cost, three dimensional fiber reinforced carbon-carbon throats for solid rocket nozzles; development of dielectric heatshield material for low observable reentry systems; and development of a boron nitride/silicon nitride/silica composite antenna window compatible with on-board guidance systems for advanced maneuvering reentry systems. These accomplishments support the development of light weight engines/aircraft and thermally protected reentry vehicles (MaRV, BGV). FY 1987 milestones include demonstration of oxidation

protected fibers for full-life (thousands of hours at 2500°F) carbon-carbon composite; completion of development of shear strength testing methods for use in high temperature oxidizing environments; continuation of efforts to identify candidate oxidation protected fiber and matrix materials for 4000°F application; continuation of efforts to develop high shear strength carbon-carbon concepts; and initiation of development efforts on next generation, high temperature antenna window materials. FY 1988 continuing efforts include development of two-dimensional strengthening mechanisms for carbon-carbon composites. FY 1988 new efforts include: demonstration of oxidation protected carbon fiber technology for up to 4000°F application; demonstration of full-life carbon-carbon composite technology for high temperature airframe structures; application of materials and processes selected for next generation high temperature antenna window and documentation of "large" window requirements; and development of qualified oxidation resistance and structural test methods for carbon-carbon. Continue to explore technology needs in the ultra-high temperature, oxidation resistant carbon-carbon composites. FY 1989 work includes: Establishment of structural limitations for brittle matrix composites and definition of strengthening mechanisms for 2-D structural composites; process optimization for 1800-3000°F Boost Glide Vehicle (BGV) structural composites. FY 1989 continuing efforts include: Development of ultra-high temperature oxidation resistant composites (3000°F); development of test methodology and material data base for ultra-high, oxidation resistant carbon-carbon composites; continued development of advanced materials to provide defense penetration capability for advanced Air Force strategic systems. These efforts are required to continue development of high temperature, light weight materials for maneuverable re-entry vehicles, high Mach air vehicle, high performance turbine engines, and the BGV.

B. (U) Project: 2419, Nonmetallic Structural Materials. This project provides new organic and carbonaceous materials having combinations of properties suitable for use over the temperature range from cryogenic to 3000°F for structural applications in Air Force subsonic and supersonic aircraft, satellites, and missile systems. It includes development of fibers, ordered polymer films and molecular composites for application in improved structural materials, and development of radar signature reduction materials for enhanced survivability. Continuing emphasis will be placed on developing organic matrix composites with increased strength, stiffness, temperature capability and durability along with reduced weight and cost. These material enhancements may be achieved in both thermosetting and thermoplastic organic matrix composites. The newer technology thermoplastic composites soften and become formable and are more ductile than the thermosetting composites (such as conventional graphite reinforced epoxy). Thermoplastics offer additional benefits of decreased production costs and increased durability. FY 1986 accomplishments include: demonstration of a new preform approach for processing thermoplastic composites; completion of a feasibility program for innovative techniques to provide three-dimensional reinforcement in composite laminates; development of process techniques for ordered polymer film materials, continuation of mechanics research to define the performance of property tailored molecular composites; and evaluation of selected high temperature material based on signature reduction concepts. These accomplishments support work towards lighter airframes and signature reduction. Projected FY 1987 milestones include: completion of development of new chemistry approaches to achieve 700°F processable resins for high temperature composite aircraft structural applications; completion of development of low-energy curing polymers with improved processability for application as high temperature/durable composite repair materials, allowing easy field repairs without the need for expensive high temperature/pressure curing vessels; completion of resin/fiber development efforts based upon acetylene terminated resin technology (acetylene terminated resin is a potentially higher temperature, higher toughness replacement for epoxy as the matrix material in aircraft structural composite materials);

completion of evaluation and transition to industry of fiber spinning and mechanical properties of high modules ordered polymers; continuation of efforts to reduce acquisition costs for thermoplastic resin composites through the development of lower cost materials and manufacturing procedures; completion of mechanics research to define the performance of molecular composites; initiation of research to improve processing and properties of molecular composites which should result in an organic composite with properties rivalling graphite/epoxy but with cost and weight savings, improved moisture resistance and improved thermal stability; and initiation of development of three-dimensional composite reinforcement processing approaches. FY 1988 anticipated completions include: development of low-energy cure polymers to simplify aircraft structure manufacture and fabrication; development of intermediate temperature (below 500°F) thermoplastic processing procedure; analytical work characterizing three-dimensional response of composites; and development of cure process modelling program. Work will continue in transitioning resin characterization to the high temperature thermoplastic processing program; and development of thermoplastic molecular composite materials and processes. Efforts will begin under the new Ultra-Lightweight Materials and Structures Initiative to develop the materials technologies required to achieve a reduction in Structural Weight of Air Vehicles by up to 50% compared to a State-of-the-art baseline vehicle. In support of this, efforts will be initiated in the areas of Molecular Composites and Advanced Carbon Reinforced Composites for Aircraft Structural Applications. FY 1989 anticipated completions include: definition of the role of biotechnology in the processing and performance of high performance matrix materials and composite structures; development of high temperature thermoplastic composite materials; development of computer-aided curing of composite structures; definition of the structural potential of high temperature carbon-carbon composite materials; and development of thermoplastics, tailored molecular composite materials and processes. Work will continue on biomaterials, supportability of thermoplastics, modelling of composite processing, with emphasis on residual stress; and achievement of nonlinear optical properties in ordered polymer systems. Efforts will continue in the areas of; advanced composites reinforced with ultra-high strength carbon fibers, molecular composites, organic fibers, and signature reduction technology. Work in this area must continue to support development of lightweight structural materials for Air Force aircraft, missiles, and communications/surveillance satellites.

C. (U) Project: 2420, Aerospace Propulsion Materials. Provides new and improved materials and manufacturing processes for components for advanced air-breathing propulsion systems for both aircraft and missiles in direct support of the DOD Integrated High Performance Turbine Engine Technologies Initiative. This initiates the potential to double the thrust-to-weight ratio of a turbine engines. Benefits will be more capability to operate in the high temperature oxidizing environment of a gas turbine engine, reduced life cycle costs, increased performance, and reduced fuel usage. This requires new materials/processes to provide lightweight, extremely high operating temperature, uncooled components with full service lives; an additional benefit will be reduced dependence on critical raw materials from foreign sources. Major developmental efforts are directed toward composite materials based on titanium aluminides, ceramics, high temperature intermetallics and refractory metals. FY 1986 accomplishments include completion of high temperature fracture mechanics applications to allow retirement of engine components for cause (predictable end-of-life); initiation of development of titanium aluminide for turbine engine use; identification of compatible high temperature materials for candidate ceramic composites and initiation of exploratory development efforts to formulate and evaluate high temperature aluminide based alloy compositions for lightweight turbine engine disk application. Projected FY 1987 milestones include completion of development of short crack behavior technology applicable to TiAl characterization; transition of fracture mechanics "retirement-for-cause" methods for turbine engine components to operational

commands to gain a large life cycle cost savings for all major engines; continuation of characterization of fatigue/fracture properties of titanium aluminides and their composites; continuation of development of reinforcement technology for high temperature (1800-3000°F) ceramic composites; initiation of exploratory development efforts to formulate and evaluate nickel aluminide based alloy compositions, as well as other very high temperature intermetallics; development of materials for oxidation resistant columbium alloys for extreme high temperature use; and undertaking an effort to devise improved computer-aided materials manufacturing, based on theoretical work accomplished for TiAl. FY 1988 goals are: significant enhancement of the High Temperature Metals and Ceramics efforts initiated under the High Performance Turbine Engine Technology Initiative. This includes the following supporting goals: identify candidate ceramic materials and increase the fracture resistance of high modulus ceramic composites; initiate the development of ultra-high temperature composite tests, testing methodology, and consideration of the required testing facilities; initiation of the development of first generation ultra-high temperature ceramic composite and of the required high temperature stable fibers to reinforce the ceramic composites; and develop and characterize first generation composites. Major goals for FY 1989 are: the development of first generation TiAl sheet product for fabrication of engine airfoils and the verification for the inherent Computer Aided Engineering developed processing methodology for hot rolling; and feasibility demonstration and characterization of a first generation very high temperature intemetallic alloy. Research in this area must continue to support the development of a high temperature, high performance lightweight turbine engine.

D. (U) Project: 2421, Fluids, Lubricants and Elastomeric Materials. This project develops advanced materials and technology for fluids, lubricants, energy transfer fluids, seals, and advanced fluid containment systems required for use in aircraft propulsion and hydraulic systems, spacecraft and missile propulsion systems and spacecraft attitude control. Nonflammable and low-temperature fire resistant hydraulic fluids will be developed as well as lubricants and seals for gas turbine engines, and explosion suppression foams for fuel systems. FY 1986 accomplishments include: completion of high temperature (350°F - 400°F) stability characterizations of the basic halocarbon hydraulic fluid and candidate additives; completion of pump validation tests on a low temperature fire resistant fluid candidate, and recommendation of optimum formulation of hydraulic fluid to the strategic and tactical operating commands; transition of the most promising -50°F to 400°F Gas Turbine Oil (GTO) formulation to the Propulsion Laboratory for engine simulation testing; development of candidate GTO seals for long-term 350°F use and short-term 600°F use; completion of development of 250°F cure adhesive sealant and fabrication of fuel containment test tanks for evaluation; transition of optimized cryocooler seal materials to Space Division and their contractors for use in long life cryocoolers for future spacecraft; completion of preliminary computer model of standard hydraulic pump; completion of synthesis of fluro-carbon (CTFE) compounds and fluids with varied molecular structures determine optimum structure-property; and and optimization of synthesis techniques for large scale quantities of fluoroalkylarylene siloxanylene polymers. These accomplishments support development of aircraft safety methods and advanced engines and airframes. Projected FY 1987 milestones include: completion of characterization of CTFE-based nonflammable hydraulic fluid and compatible elastomeric seal materials for application to future flight vehicles; transition of fluoroalkylarylene silahydrocarbon polymers to the manufacturing science program for low cost production development; completion of 400°F fuel/lubrication seal material development for application in advanced high temperature turbine engines; low temperatures cure adhesive sealant for service temperatures to 350°F for application as fuel tank sealant material; initiation of development of very high temperature gas turbine engine lubricants; and continued development of high temperature (300°F) resistant,

conductive explosion-suppression, fire-resistant material for fuel tank protection in future aircraft. In FY 1988, the military standard gas turbine oil will be replaced by a completely tested 400°F oil; a halocarbon nonflammable hydraulic fluid will be transitioned to the product divisions for service in 350°F, 8000 psi application, and the 500°F elastomeric seal materials and designs will be transitioned to engine manufacturers. In FY 1989, work on a 350°F conductive explosion-suppression foam will be completed; the fundamental technology base for solid lubricated ceramics will be completed; synthesis of 700°F elastomer candidates will be completed; and development of 600°F-700°F hydraulic fluid and high modulus seal materials will be initiated. Continued development work in this project is required to insure safe, high performance fluids, lubricants and elastomers for applications in high Mach vehicles and engines.

E. (U) Project: 2422, Protective Coatings and Materials. This project provides materials and concepts to enhance survivability of aircrews and vital components of Air Force aircraft, missile and communication/surveillance satellites in natural and weapon threat environments. Although related to the materials needs identified in other projects in PE 62102F, materials considered in this project primarily have a protective function that is essential to the survival of the crew, avionics, and other critical subsystems of the military systems. Materials developed for Air Force satellites includes survivable thermal management (coating) materials which reduce the problem of contamination of spacecraft surfaces while enhancing life and survivability. Aircraft and missile system materials efforts are directed toward development of vehicle camouflage (visible band), and observables reduction in nonvisible bands. Materials applicable to hardening aircraft, and missiles against lasers is also under development. Multiple laser hardening optical concepts such as filtering, switching, and limiting are being developed for hardening of strategic and tactical systems and components, including personnel. In FY 1986 accomplishments include: development of spacecraft radiator coatings hardened against ground based lasers, the development of a personnel laser protection visor which was directly transitioned to the Life Support office of Aeronautical Systems Division; the Forward Looking InfraRed (FLIR) hardening technology was directly transitioned to the Maverick missile development office of Aeronautical Systems Division; continued materials testing to meet the spacecraft outgassing/condensation criteria; completion of multi-layer pigment technology for aircraft coatings; identification of candidate switch/limiter material concepts to protect tactical systems against multi-wavelength lasers; demonstration of optical filters to protect crew members and sensitive target sensors from visible and infrared wavelength lasers, completion of spacecraft materials contamination characterization, demonstration of mobile notch filters for multi-wavelength laser protection; and demonstration of the availability of nonlinear polymers for switch/limiter laser protection of tactical systems. Projected FY 1987 milestones include completion of spacecraft material contamination characterization enabling extended on-orbit life of future satellites; completion of survivable thermal control coatings development which will enhance the survivability of large spacecraft radiator surfaces under laser or nuclear attack, demonstration of solid state multiple wavelength filters enabling protection of electro-optical systems and personnel from multi-wavelength lasers; continuation of the development of spacecraft radiation coatings hardened against space based lasers; continuation of development of lasers/nuclear hardened multi-layer insulation spacecraft blanket materials continuation of the efforts to develop organic materials to useful nonlinear optical materials; and initiation of efforts to develop superlattice structures (multilayer semiconductor material) for laser hardening applications. In FY 1988, the exploratory development of nonlinear organic materials for the protection against agile/pulsed laser threats will be completed; thermal flash coatings development will be completed; advanced thermal control coatings will be transitioned to Space Division; development will continue in multi-threat survivable spacecraft coatings and in superlattice hardening technology to

counter advanced laser threats; and an effort will be initiated to develop stabilized colloidal array filters for laser protection of electro-optical devices. In FY 1989, computer controlled process technology will be demonstrated for production of high quality, multi-wavelength notch filters. Development of prototype devices for agile laser protection will be initiated. Photorefractive crystals and ferroelectrics will be developed to begin laser response testing. Development of nonlinear optical materials and ultrastructured materials for laser hardening of tactical systems to multiple band laser threats will begin. Development of multi-threat survivable spacecraft coatings will be completed; development of laser/nuclear hardened multi-layer insulation spacecraft blanket materials will be completed; development of intrinsically hardened thermal control materials will be completed; and optimized/standardized materials selection criteria will be transitioned to Space Division and industry. These efforts need to be continued to ensure advanced survivable Air Force tactical and strategic weapons systems.

F. (U) Project: 2423, Electromagnetic Windows and Electronic Materials. This project develops materials and materials processes for optical, electromagnetic, and electronic subsystems for Air Force aircraft, missile and satellites systems. These materials are required for application to a broad range of electromagnetic and electronic devices and components critical to system operation in natural and weapon threat environments. Present emphasis is to develop high performance infrared detector materials for strategic and tactical detector arrays; high purity, low defect gallium arsenide crystals for monolithic microwave integrated circuits essential for development of advanced airborne radar; ceramic radomes for high speed tactical missiles; and solder/packaging technologies for ceramic leadless chip carriers essential for development of reliable very large scale integrated circuits components/systems. FY 1986 accomplishments include: transition of liquid phase epitaxy for mercury cadmium telluride infrared (IR) detector materials to manufacturing technology for scale-up and automation; optimization of growth and processing technology to achieve vehicle frequency sensitivity in silicon IR detectors; scale up to 8 kilogram melts of gallium arsenide which should increase wafer yield from 35 wafers per boule to over 100; and fabrication and rain erosion testing of full scale ceramic composite broadband radomes. Projected FY 1987 milestones include: completion of development of lower cost, higher yield processing technology for vapor phase deposition of high purity layers of epitaxial mercury cadmium telluride; continuation of development of high purity extrinsic silicon infrared detectors; continuation of work to achieve lower cost, higher yield advanced gallium arsenide crystals for advanced integrated circuits; development of more reliable wiring board systems; completion of development of broadband (at high temperature) ceramic radomes for tactical air-to-air missiles; and initiation of an advanced mercury cadmium telluride surface passivation effort to enable the development of high performance, low leakage detectors for the long wave infrared band. Anticipated FY 1988 goals include: initiation atomic and molecularly tailored Ultra-Structure/Superlattice materials with high potential for order of magnitude increase in capability in the areas of infrared detectors and other semiconductor devices; begin the Non-Linear Optics Initiative with its high potential payoff to Optical Computing and other photonic device technology. Development of an advanced gallium arsenide processing model; completion of exploratory development efforts in tailorable multi-layer printed wiring boards; continued development of detectors for strategic and tactical surveillance/imaging applications; continued development of improved gallium arsenide growth techniques; initiation of an effort to develop molecular beam crystal growth technology and initiation of two program areas in inorganic nonlinear materials, and molecular beam epitaxy process development for ultrastructures. Anticipated FY 1989 goals include: completion of assessment of indium doping in gallium arsenide wafers to increase microwave device yield, and continued work on gallium arsenide materials for higher frequency; continued superlattice detector materials development with

emphasis on manufacturing research in photo-assisted and gas source molecular beam epitaxy, and continued work on alternate approaches for long wavelength extrinsic detector; initiate nonlinear multiple quantum well materials investigations; and continue inorganic Nonlinear Optic materials development. Work in this area must continue to develop electronic materials to support future tactical weapons systems and surveillance systems.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2418, Metallic Structural Materials

A. (U) Project Description: This project provides reliable advanced metallic materials and processes with optimum combinations of properties from cryogenic temperatures to 1800°F for potential use in tactical and strategic aircraft structures and turbine engines. Special emphasis is on rapid solidification technology (RST), powder metallurgy for aluminum and titanium alloy development, and metal matrix composites. A goal of 1800°F service temperature established for RST titanium alloys is approximately a 600°F increase in capability and will allow the use of lower cost, easier to work structural materials, which provide a 40 percent weight reduction over superalloy, for design of future Air Force aircraft systems. It provides for development of the advanced technologies required to increase productivity for future Air Force manufacturing and maintenance processes. It also provides the development and breadboard feasibility demonstration of advanced Non Destructive Inspection and Evaluation (NDI/E) technology for quality and integrity assurance of aerospace materials and structures in support of the life cycle engineering effort.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Accomplishments include: generation of initial mechanical property data base on second generation high strength corrosion-resistant powder metallurgy aluminum alloys; identification of one or more approaches to provide low density powder metallurgy aluminum alloys with 16 percent lower density than conventional alloys; identification of a process method to allow high temperature aluminum powder alloys to be fabricated into sheet and extrusion products; deciding on a process to make production quantities of rapidly solidified titanium powder; identification of alloys/process combinations for 1200°-1300°F elevated temperature titanium alloy; feasibility demonstrations of a dual energy x-ray method to image hidden corrosion and a microencapsulated dye inspection method to indicate hidden impact damage in composite structures; demonstration of a modelling concept to optimize NDI/E reliability; development of post mortem techniques for the analysis of structural defects; continued provision of quick reaction materials and processes support to Air Force Systems Command product divisions, Air Force Logistics Command and operational commands; and transition of improved materials processes to systems use. Programs were initiated to develop a failure analysis handbook for structural composites, to develop an electro-deposited paint primer for aircraft, and to develop an "expert system" computer program for performing failure analysis on metallic structures.

(2) (U) FY 1987 Program: Efforts planned for completion include: characterization of crack propagation for corrosion resistant high strength powder metallurgy aluminum; development of scaleable processing to convert aluminum powder to a full-range of high temperature resistant product forms without mechanical property loss; evaluation of a

potentially high production rate process for providing large quantities of contamination free rapidly solidified titanium powder; complete development of a corrosion prediction model for transition to Air Force Logistics Command and industry; and development of inspection techniques for high temperature coatings and a probability of detection model for ultrasonic inspections. Several X-ray tomographic inspection techniques are planned for transition into advanced development in PE 63211F. New initiatives include: an effort to define the practical limits of thermal stability and high temperature mechanical properties of aluminum and titanium based materials; development of Rapid Solidification Technology (RST) magnesium alloys which are corrosion resistant and provide a 40 percent weight reduction over current structural aluminum alloys; advanced processing of metallic foils for flare applications; Non Destructive Inspection/Evaluation (NDI/E) efforts in high temperature coatings; validation of an ultrasonic NDI/E reliability prediction model; inprocess control for electronics manufacturing; a laser-based advanced ultrasonic NDI/E program; and a program for the development of paint removal and surface protection techniques for composites. Work will be continued in: enhancement of the capability of analytical and computer support to the laboratory research and development program; development of the processing science technology base for automated process control and quality assurance; development of an eddy current NDI/E reliability model; advancement in high resolution X-ray computed tomography; quick reaction support to solve material and process problems in Air Force Systems Command product divisions Air Force Logistics Command and operational commands and transitioning improved materials and processes to systems use.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: FY 1988 funding is required to complete the following efforts: the processing development for aluminum powder alloy to allow use at increased temperatures up to 450°F; titanium powder metallurgy and rapid solidification technology program; composite curing process and nondestructive evaluation development; an expert computer system for failure analysis. Funding is required to support the 900°F Aluminum and 1800°F Titanium Powder Metals Initiatives, which are part of the High Performance Turbine Engine Technology program; as well as the related technologies of Oxidation Protection Coatings and Nondestructive Evaluation for Engine Components. Initiatives that also require funding include small defect detection and characterization for turbine engine components; exploration of new methods to inspect critical adhesive bonded joints; and investigation of high temperature composites supportability. NDI/E techniques to rapidly inspect large composite structures are planned for transition to PE 63211F. Efforts in rapid solidification technology will result in scale-up of processing and property characterization demonstrations in support of ultralight structures research and the exploration of the concept of ultrastructure or nanocrystalline materials technology and adaptation for structural component application will continue. This program must be continued to support development of lightweight metallic structures to support advanced weapons systems, especially the High Performance Turbine Engine initiative.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: FY 1989 funding is required to complete the following: definition of practical limits of thermal stability in high temperature resistant metal forms; development of NDI/E for high temperature protective coatings in turbine engine materials; and development of laser-based ultra-sonic methods and modelling of eddy current non destructive fault detection reliability. Funding is required to continue ultra-high temperature aluminum and titanium alloy synthesis and processing development; ultra-light structures technology; the development of metal matrix composites the development of reinforced magnesium metal matrix composites; examination of ultrastructured and nanocrystalline materials concepts to exploit the major benefits potentially existing for structural applications; the investigation of thermoplastic composites supportability;

detection methods for small volumetric defects in turbine engine materials; and validation of an ultrasonic reliability prediction model. New initiatives that require funding include a program to exploit Metal Matrix Composite (MMC) technology as a method of obtaining ultra-lightweight structures and ultra-high temperature, lightweight structures (these MMC materials will capitalize on the gains offered by rapidly solidified alloys as matrix alloys); and a program for bolted/bonded repair of composites; new corrosion detection methods; metal-metal bonding Non-Destructive Inspection Evaluation (NDI/E), and minute flaw imaging inspection methods for aircraft components. Work in this project must continue to assure adequate lightweight high strength metals are available for future Air Force aircraft, missiles and satellites.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not applicable.

9. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 06ML, Laboratory Operations

A. (U) Project Description: This project provides for management and support of the Materials Laboratory and includes the pay and related costs of civilian scientists, engineers and supporting personnel, travel, transportation, rents, communications, utilities costs, procurement of supplies and equipment, and contractor support services. It also funds salaries, travel, and equipment for personnel at Aeronautical Systems Division providing procurement support to the laboratory. The Materials Laboratory is responsible for the Air Force exploratory and advanced development programs in the area of materials technology, a portion of the basic research program in materials, and for administrative support of the Air Force Manufacturing Technology program.

B. (U) Program Accomplishments and Future Efforts: Not Applicable.

C. (U) Major Milestones: Not Applicable.

10. (U) COOPERATIVE AGREEMENTS: Not applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62201F
DOD Mission Area: 523 - Engineering Technology (ED)

Title: Aerospace Flight Dynamics
Budget Activity: 1 - Technology Base

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	63,539	65,826	70,087	72,059	Continuing	N/A
06FF	Laboratory Operations	31,088	31,500	32,880	33,481	Continuing	N/A
2401	Structures and Dynamics	8,463	8,925	9,674	10,030	Continuing	N/A
2402	Vehicle Equipment	5,822	6,179	6,697	6,944	Continuing	N/A
2403	Flight Control	8,241	8,925	9,674	10,030	Continuing	N/A
2404	Aeromechanics	8,027	8,582	9,302	9,645	Continuing	N/A
3038	Technology Integration and Assessment	1,898	1,715	1,860	1,929	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides the flight vehicle technologies required for the design and development of future aerospace vehicles (aircraft, missiles, and spacecraft) and for the improvement of current vehicles. It encompasses the technical areas of structures, aerodynamics, flight performance analysis, vehicle dynamics, crew station design, environmental control, mechanical subsystems, survivability/vulnerability, and technology integration and assessment. The program also provides for the management and support of the Flight Dynamics Laboratory, Wright-Patterson AFB, OH. This is a Science and Technology effort.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	68,749	70,281	72,614	N/A	Continuing	N/A

EXPLANATION: (U) The decrease in FY 1986 funding is due to Gramm-Rudman-Hollings. The decrease in FY 1987 funding is due to Congressional action. The decrease in FY 1988 funding is due to reductions in Air Force Total Obligation Authority.

4. (U) OTHER APPROPRIATION FUNDS: Not applicable.

5. (U) RELATED ACTIVITIES: This program receives technology inputs from In-house Laboratory Independent Research (PE 61101F), Defense Research Sciences (PE 61102F), and Materials (PE 62102F), as well as from other national and international research and development activities. In turn, the technology product of this program is applied to Flight Vehicle Technology (PE 63205F), Aerospace Structures and Materials (PE 63211F), Advanced Flight Technology Integration (PE 63245F), Variable Stability In-Flight Simulator Test Aircraft (PE 64237F), and other advanced, engineering, and

system development programs. Cooperative and jointly funded projects are conducted with other Air Force laboratories and organizations, the Army, the Navy, the National Aeronautics and Space Administration, and foreign countries. Coordination and avoidance of duplication of effort is accomplished through exchange of information, coordinating and advisory groups, technical reviews and seminars, professional societies meetings, and through the preparation of technical reports.

6. (U) WORK PERFORMED BY: This program is managed by the Flight Dynamics Laboratory, Wright-Patterson AFB, OH. The top five contractors are Boeing Co., Seattle, WA (2401, 2402, 2403, 2404); General Dynamics Corp., Ft Worth, TX (2401, 2403, 2404); Lockheed Aircraft Co., Burbank, CA (2401, 2402, 2404); McDonnell Douglas Co., St. Louis, MO (2401, 2403, 2404); and Northrop Corp, Hawthorne, CA (2401, 2402, 2404). The total number of additional contractors is 88, with a total contract value of $78.0 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 2402, Vehicle Equipment. This project develops the technological base and demonstrates new capabilities in: (1) flight vehicle ground mobility, takeoff and landing systems; (2) transparent crew enclosures; (3) cryogenic cooling; (4) aircraft environmental control; (5) flight vehicle vulnerability; (6) emergency crew escape; (7) robotics for aircraft ground servicing and maintenance; and (8) reliability assessment and technology. The goals are to reduce the life cycle cost of subsystems and equipment, increase the probability of flight vehicle and crew member survival, and improve flight vehicle operational capabilities. During FY 1986, this project successfully demonstrated several improvements in aircraft subsystems and transitioned the technology to advanced development programs and System Program Offices. An electric brake that eliminates the vulnerable hydraulics in conventional brakes was demonstrated on an A-10 testbed. An integrated braking system, one that combines the functions of steering, rudder control and braking, was simulated in the laboratory. This system is being developed to reduce the significant problems associated with landing on narrow runways in high crosswinds. The operating capabilities of new landing gear capable of landing on rough, soft or short fields have also been evaluated. For the uniform standard protection of avionics subsystems, lightning has been characterized and compared with nuclear electromagnetic pulses. The characterization will be incorporated in computer analysis routines to determine the susceptability of avionics subsystems to the threat of lightning and nuclear threats. In FY 1987, this project, anticipating the need of high speed, high altitude crew escape systems for future vehicles such as the Advanced Tactical Fighter, will complete the preliminary design of an escape capsule for safer pilot ejection from aircraft. Efforts will continue to provide substantial improvements to landing gear reliability, durability, maintainability, and life-cycle cost. The most severe environmental stress factors encountered by avionics systems and other components are due to high vibration and temperature. Computer analysis programs were completed that will assess reliability of new avionics designs in these severe environments and will combine with the methodology to allow trade-offs between various components. In addressing the need for new methods to actively cool subsystems, a low weight, small size, no-maintenance dry compressor for a helium liquefaction system for sensor cooling applications will be developed. The higher landing and take-off speeds of future aerospace vehicles will prompt the initiation of a program to develop high temperature resistant tires by using advanced materials, construction techniques and design approaches. The program planned for FY 1988 includes the development of computer analysis techniques and experimental methods to predict the vulnerability of aircraft to any given ballistic

threat. Due to the many parts and joints, cockpit windshields, or canopies, have the lowest reliability, maintainability and durability. A program will be initiated to develop a frameless, molded canopy that is lighter and costs less than conventional canopies. In support of the Hypersonic Vehicle initiative, two programs will be started: a program to develop a crew escape capsule, and a program to develop a thermal management system. Two programs addressing improved maintenance of aircraft will be initiated. For aircraft that must be moved to a staging area over rough terrain or water, the technology to develop an air cushion transporter will be transitioned to the logistics community. Bench models of robotic systems for aircraft ground maintenance will be developed. The vulnerability assessment of composites to ballistic damage will be transitioned to the Product Divisions. The planned program for FY 1989 addresses adverse affects of chemical/biological agents on aerospace vehicle subsystems. In one program, a closed environmental control system (ECS) will be developed and evaluated in the laboratory. In a parallel program, a chemical/biological agent avoidance system will be developed and evaluated in the ECS. Ground mobility concepts for tactical transport aircraft, such as the air cushion transporter, will be developed. Advanced on-board inert gas generating systems for preventing aircraft combat fires will be assessed.

B. (U) Project: 2404, Aeromechanics. This project plans and conducts technology programs in the areas of aerodynamics, aerothermodynamics, performance analysis, configuration research, wind tunnel and flight experiments. These technology programs are directed toward obtaining improved mission capability and survivability, reduced development risk, and reduced cost. Examples of FY 1986 accomplishments include: completed Boost Glide Vehicle configuration research and transitioned development to 6.3 programs; developed design criteria and verified concept for low radar cross section inlets applicable to future aircraft; experimentally determined the flow environment for advanced weapon carriage techniques applicable to the launch of air-to-ground and air-to-air weapons; developed a flow visualization water tunnel for investigation of high angle-of-attack flight, leading edge vortex flaps, and Vertical/Short Take-off or Landing (V/STOL) interaction; developed transatmospheric vehicle configuration concepts, including the impact of aerodynamic heating on the maneuvering capability for up to 3000 nautical mile range; made significant progress on experimental diagnostic techniques to determine flow/fields effects on hypersonic vehicle designs; and obtained experimental data on the V/STOL advanced tactical transport concept. During FY 1987, the project will concentrate on the inlet/nozzle airframe integration for advanced airbreathing vehicles in the Mach 4 to 6 regime to support the initiative in Hypervelocity technology. Innovative weapon carriage concepts will be tested to define the most viable approach for successful supersonic launch. An analysis program will be developed to provide aero-acoustic prediction of weapon bay environment. The effects of maneuvering performance on the design, survivability, flexibility, affordability, and reusability of future hypervelocity vehicles will be completed. A joint effort with the Aero Propulsion Laboratory will continue to examine the application of advanced configurations and air-breathing propulsion systems for the entire spectrum of supersonic air-launched missiles which reduce flight time by 50 percent. The subsonic aerodynamic research laboratory wind tunnel check-out and calibration will be well underway to provide a unique test capability. New activity in the project will support the V/STOL initiative by investigating designs that take advantage of the technology gains offered by optimizing the interaction of aerodynamic and propulsive systems to achieve controllable flight. This project will also perform research in support of the Hypersonic Aerothermodynamics initiative by examining flight in the high altitude/low density regime and the effect on aerodynamics and aeroheating of hypersonic vehicles. During FY 1988, many of the programs mentioned above will continue with the addition of new efforts in: configuration concepts for V/STOL fighters based on technology efforts of the past years; weapon configuration and weapon separation at

hypersonic speed from hypersonic vehicles; advances in computational fluid dynamics codes for application to the design of hypersonic and Vertical/Short Take-off or Landing (V/STOL) vehicles; experimental investigation of low aspect ratio vehicles at subsonic/transonic speeds; and continued research on lift augmentation for V/STOL application and maneuver enchancement. The subsonic aerodynamic research laboratory will be fully operational and used to experimentally investigate high angle-of-attack aerodynamics and propulsion/airframe integration at high angles-of-attack to improve aircraft maneuverability, and to provide much needed experimental data for computation fluid dynamics code verification. An effort to investigate hybrid laminar flow control for possible application to global range transport is planned. Long endurance aircraft configurations will be examined for potential to achieve days and months of flight. Activity will be initiated to analyze hypersonic cruise configuration, including performance and the propulsion/aerodynamics interfaces inherent in these highly integrated vehicles. During FY 1989, efforts include low gas density aerodynamics and aeroheating and V/STOL configuration development. New efforts will be initiated in active cooling, including effects on nosetips and leading edges of hypersonic vehicles. An effort is planned to examine the flow environment and its impact on the functions and survivability of sensors and windows. Configuration efforts will be initiated to examine the airframe/propulsion integration, aerodynamic heating and controllability and terminal flight constraints. The investigation of flow separation on primary lifting surfaces will be initiated to determine methods of maintaining controllable flight. Lift augmentation research, using both leading edge and trailing edge devices, will continue. A nozzle performance effort will be started to investigate techniques to obtain efficient operation in an acceleration mode from take-off to hypersonic cruise in the Mach 8-12 regime. Experimentation to provide a sound data base for verification of computational fluid dynamics methods will continue, especially in the hypersonic area.

C. (U) Project: 3038, Technology Integration and Assessment. This project performs advanced vehicle concept synthesis, and technology integration and assessment to identify future military options available with new technologies. Advanced vehicle design concepts, technology applications, and an integration data base are the products accomplished through analysis of systems concepts, operational requirements, technology tradeoffs, and designs of flight vehicles. During FY 1986 this project accomplished the following: designed and assessed two types of tactical transports, i.e., a highly survivable Vertical/Short Take Off and Landing transport and a low-cost, cruise efficient short take-off and landing transport; completed an investigation identifying concepts and technologies for deployment and employment of tactical aircraft in future third world conflicts; completed an investigation to determine the value of tactical operations from low earth orbit; and completed development of algorithms for maneuver-induced survivability of future fighter aircraft. During FY 1987, 1988, and 1989, this project is directed toward three areas: Global Tactical War Fighting, Control of Space, and Multi-mission Core Technology. The objective of the Global Tactical War Fighting assessment is to understand the role of technology relative to the global tactical perspective by obtaining a balanced assessment of the total world-wide tactical needs, understanding the key operational and system drivers, and exploiting opportunities for future development. The objective of the Control of Space assessment is to investigate the technological and operational issues associated with the integration of the reentry vehicles with the carrier vehicle. Multi-mission Core Technology includes five methodology areas: design, vehicle characteristics prediction, mission analysis, operation effectiveness and cost effectiveness. The objective of this element is to develop methods in these areas, to integrate these methods to develop the understanding to choose the best methods for the task, and to develop the knowledge to properly interpret the results generated. During FY 1987, efforts will be initiated to determine mission related technology figures of merit and to assess applicable technologies for aeronautical systems.

During FY 1988, this project will continue the development of rationale for laboratory investment strategy using the three major goals previously described, and continue the efforts to understand the need and associated technologies for several aeronautical systems. These systems include the supersonic Vertical/Short Take Off and Landing Tactical Fighter, Multi-Role Global Range Aircraft, High Altitude Long Endurance Aircraft, Hypersonic Interceptor Aircraft, Multi-Mission Remotely Piloted Vehicle, and Covert/Clandestine Aircraft for special operations. During FY 1989, technology assessment efforts will continue with the emphasis on defining the military payoff of advanced technology. Specific efforts will be initiated on selected Air Force systems initiatives, explored in FY 1987 and 1988, to quantitatively define the required technology development and the respective military effectiveness of these systems integrated into mission oriented scenarios. The payoff will be a technology assessment that identifies critical technology capabilities, including military effectiveness, quantification of performance parameters, development of status, risk, and system integration requirements.

8. (U) PROJECTS OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2401, Structures and Dynamics

A. (U) Project Description: This project focuses on critical structural, dynamic and aeroelastic technology issues which affect the producibility, performance, safety, durability, and cost of aerospace vehicle structures. It sustains the Air Force's in-house Technology Base of structural analysis, design and test methods. It also develops design methods and test methods to develop survivable aircraft structures. It develops new structural concepts to increase strength and stiffness at minimum weight, complexity, and cost. This includes the exploitation of new material and fabrication processes.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: This project demonstrated an interim method to simulate laser-induced structural damage at less than one percent of the cost of a full-scale laser test. A typical test program now will cost less than $5,000 for one week of testing, instead of the former costs of approximately $500,000. The project completed the development of a method to acoustically detect, identify and track aircraft flying at altitude below radar or at extreme distances (beyond the curvature of the earth). Initial wind tunnel tests were completed on the innovative "active flexible wing" which allows wings to be flexible, and lighter, by increasing the effectiveness of multiple control surfaces. The experimental fatigue data base was expanded to assess fatigue properties of new aluminum alloys, high temperature superalloys, and new composite structures. The first phase of the structural design of a hypersonic boost-glide vehicle was completed.

(2) (U) FY 1987 Program: This project will complete the structural evaluation of a new aluminum alloy which can operate at temperatures up to 600°F (a 30 percent improvement), allowing for the replacement of titanium in some applications and reducing the cost of fabrication to 25 percent for those parts. This technology will transfer to Advanced Development under PE 63211F, Aerospace Structures and Materials. This project will also: develop methods to predict the internal and external aeroacoustic environments for hypervelocity vehicles; develop full-scale high

temperature test facilities for structural fatigue and fracture; and begin the process of training industry to use the new specialized aircraft analysis and design computer programs for aeroelasticity and automated design.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: This project will complete the development of new aircraft structural concepts which resist ballistic and laser damage and will transfer the technology to Advanced Development under PE 63211F. In the area of ultra lightweight materials and structures, an effort will be initiated to develop methods to take advantage of the synergistic effects of structures, flight control and aerodynamics (aeroservoelasticity) to drastically reduce airframe structural weight. For the Boost Glide Vehicle and other hypersonic vehicles, candidate structures and active and passive methods to cool the vehicle structures during sustained hypersonic flight will be developed. Emphasis will increase in the development of dynamic test methods for aircraft and spacecraft structures in support of several systems, including the hypervelocity vehicle. The project will remain the Air Force's center of in-house expertise for the static, thermal and dynamic testing of full-scale and reduced scale aircraft and spacecraft structures.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: This project will complete the evaluation of fabrication methods for new lightweight aluminum-lithium alloys to reduce fabrication costs to less than 75 percent of previous assembly methods. Integral damping to reduce structural noise and vibration in combat aircraft aft equipment bays will be completed and transitioned to Advanced Development. In order to validate analytic techniques, fabrication and testing of candidate structures representing vertical/short take-off and landing transports and fighters, hypersonic aircraft, and boost glide vehicles will begin. An analytical/test program to determine the structural effects of integrating aircraft antennas, sensors, preprocessors, and electronic control cables into the aircraft skin will be initiated.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not applicable.

9. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR 1989:

(U) Project: 2403, Flight Control

A. (U) Project Description: Flight control system design is critical to flight safety and battle survivability. This project provides the technology for survivability, stability and flight path control requirements and for obtaining maximum performance of advanced flight vehicles throughout relevant flight envelopes. This project develops control theory, performs aerospace vehicle simulation and analysis, designs cockpit concepts and pilot/vehicle interface design and integration criteria, develops stability and control methods, develops control sensors and actuators, conceives new control system architectures, integrates flight control with other systems, and develops control system design methods.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: This project completed several efforts to enhance aerospace vehicle flying qualities. To reduce workload and improve the quality of information provided to the pilot, pictorial format displays and expert systems, as well as other new cockpit concepts, were demonstrated. To improve flying qualities and pilot/vehicle interface, the first phase of a piloted short take-off or landing (STOL) simulation was completed for transition to the Advanced Development STOL Manuevering Technology Demonstration project in PE 63245F, Advanced Flight Technology Integration. The large amplitude motion base simulator was used to demonstrate low-altitude ride qualities in turbulence as part of an evaluation of terrain avoidance systems for low flying fighter aircraft. Artificial intelligence techniques to instantaneously select flight paths for terrain and threat avoidance during low level flight were demonstrated.

(2) (U) FY 1987 Program: Two major programs will be initiated: (1) hypersonic vehicle control, which include stability and control systems architecture crew stations and high temperature control actuators for these high speed, high altitude aircraft; and (2) rapidly reconfigurable crewstation to provide quick design and evaluation capability for cockpits, thereby cutting years of lead time from current development approaches. Studies will continue on supermanueverability; that is, expanding the manueverability of fighter aircraft and boost glide vehicles in the very low and very high speed regimes to allow improved evasive manuevers. The studies will concentrate on the design criteria for control at very high angles-of-attack, a region in which aircraft typically have limited control capability. A program will be initiated to improve effectiveness, survivability and supportability of flight control systems by increasing the time between routine maintenance to 3000 hours. The application of very high pressure (8000 pounds per square inch) hydraulic actuators and electromechanical developments will increase reliability. A fighter battle management simulation capability will be defined to incorporate cockpit automation concepts allowing the pilot to operate effectively (win and survive) in complex tactical combat and severe natural environments. Major ground-based engineering simulation capabilities will be interconnected with Air Force Wright Aeronautical Laboratories Avionics Laboratory computers to increase the breadth of system integration simulation.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Previous efforts will continue and new programs will expand on these efforts to address the complex nature of controlling highly manueverable fighters, hypersonic vehicles and spacecraft. To increase the capability of tactical fighters to land in adverse weather (without on-board systems that emit signals capable of being tracked by hostile radar), a program will be initiated to investigate new landing control systems. To reduce the complexity associated with flying future aerospace vehicles, programs will be initiated to evaluate new cockpit designs. These efforts will include the simulation and crew mock-up of the designs. Among these is a program that will allow the integration of flight control and propulsion control necessary in STOL vehicles. The technology will be transitioned to PE 63245F, Advanced Flight Technology Integration, for the STOL Technology Demonstrator program. A program will be initiated to develop fault tolerant flight critical software. This program will develop software capable of overcoming errors or damage to the control system computer.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Efforts addressing the special nature of hypersonic flight will continue. In FY 1989, an effort will be initiated to develop the techniques for control and

the hardware necessary to actuate the control systems in the high temperature environment of the vehicle. Mission management systems developed for fighter aircraft will be expanded to strategic bombers, tankers and transports. These systems will combine guidance, navigation and control to maximize combat effectiveness and survivability. Integration of the aircraft systems by consolidating electric and hydraulic power, fuel, and environmental systems will be continued resulting in fewer on-board computers. Efforts developing design criteria to expand fighter manuever capabilities will be completed. These studies include the effect of cockpit displays on the pilot's ability to perform the manuevers. The program to evaluate several control system designs for the boost glide vehicle will be completed.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not applicable.

10. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 06FF, Laboratory Operations

A. (U) Project Description: This project provides for the management and support of the Flight Dynamics Laboratory, Wright-Patterson AFB, OH. It includes pay and benefits for civilian engineers, scientists, and support personnel; travel, transportation, rents, communications, computer networks, and utilities costs; and procurement of supplies, equipment, and contractor support services. It also funds salaries, travel, and equipment of personnel at Aeronautical Systems Division that provide procurement support to the laboratory. This project supports and complements all the other projects in this program element.

B. (U) Program Accomplishments and Future Efforts: Not applicable.

C. (U) Major Milestones: Not applicable.

11. (U) COOPERATIVE AGREEMENTS: Not applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62202F
DOD Mission Area: 552, Environmental and Life Sciences (ED)

Title: Aerospace Biotechnology
Budget Activity: 1 - Technology Base

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	45,902	46,332	47,939	54,996	Continuing	N/A
06MD	Aerospace Medical Division Laboratory Operations	23,666	23,866	23,500	24,143	Continuing	N/A
2729	Chemical Defense	3,057	2,851	2,940	3,730	Continuing	N/A
6302	Occupational & Environmental Toxic Hazards in AF Operations	4,035	2,826	2,900	3,680	Continuing	N/A
6770	Biotechnology Studies in Advanced Systems	309	350	699	730	Continuing	N/A
6893	Manned Weapon Systems Effectiveness	1,735	1,435	1,550	1,965	Continuing	N/A
7184	Man-Machine Integration Technology	3,364	5,892	6,350	8,050	Continuing	N/A
7231	Safety & Acft Effectiveness in Mechanical Forces Environments	3,035	2,807	3,300	4,190	Continuing	N/A
7755	Aerospace Medicine	1,001	806	900	1,140	Continuing	N/A
7757	Radiation Hazards in Aerospace Operations	3,260	3,346	3,600	4,578	Continuing	N/A
7930	Advanced Crew Technology	2,440	2,153	2,200	2,790	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Aerospace Biotechnology is a Science and Technology effort. It is the core Air Force program to develop the technology necessary to optimize the role of the human operator in the design, development, and operation of increasingly complex and technologically sophisticated weapon systems. The five key thrusts for the biotechnology program are: (1) improve the performance of the human component of weapon system operations by refining crew selection, crew protection, and man-machine integration; (2) improve safety and protect Air Force personnel from radiation, chemical, and mechanical forces; (3) use our understanding of human factors to invent threats and countermeasures effective against Soviet weapon system operators; (4) develop chemical defense measures for air base operations, casualty care evacuation, and personal protective equipment; and (5) exploit and optimize man's utility in military space systems. This program also provides management and operational support for the three laboratories of the Aerospace Medical Division.

Program Element: 62202F
DOD Mission Area: 552, Environmental and Life Sciences (ED)

Title: Aerospace Biotechnology
Budget Activity: 1 - Technology Base

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
RDT&E	48,136	53,371	55,447	N/A	Continuing	N/A

EXPLANATION: (U) FY 1986 reflects Gramm-Rudman-Hollings reduction. FY 1987 reduction is due to Congressional action. FY 1988 reduction accommodates reductions in Air Force Total Obligation Authority.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: The biotechnology program is formally coordinated with the Army, the Navy, and the National Aeronautics and Space Administration through a variety of mechanisms including the Tri-service Aeromedical Research Panel and the Human Factors Engineering Technical Advisory Group. Where coordination is required on a daily basis, operating locations have been established with other organizations. These include Air Force positions with: HQ Army Medical R&D Command, Fort Detrick, MD; Army Institute of Chemical/Biological Defense at Aberdeen Proving Group, MD; Army Aeromedical Laboratory, Fort Rucker, AL; Naval Medical Research Institute, Bethesda, MD; and Johnson Space Center, Houston, TX. Related program elements include 62720A Environmental Quality Technology, 62777A Systems Health Hazard Prevention Technology, 62205F Training/Simulation Technology, 63227F Advanced Simulator Technology, 63231F Crew Systems Technology, 64703F Aeromedical Systems Development, 62204F Aerospace Avionics, 62702F Command, Control, Communications and 61102F Defense Research Sciences.

6. (U) WORK PERFORMED BY: The Biotechnology Program is conducted by the Aerospace Medical Division through its three laboratories: the United States Air Force School of Aerospace Medicine, Brooks AFB, TX; the Harry G. Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH; and the Air Force Human Resources Laboratory, Brooks AFB, TX. The in-house portion of the program is centered on unique, complex, man-rated experimental facilities at each of these laboratories. Such facilities are generally not available in the aerospace industry or academic institutions. The contract portion of the program complements the in-house efforts. The five major contractors are: MacAulay Brown, Inc., Fairborn, OH (Project 7184); Science Applications, Lajolla, CA (Project 7184); Systems Research Lab, Dayton, OH (Project 7184); Northrop Services, Inc., Research, Triangle Park, NC (Project 6302); University of Dayton, Dayton, OH (Project 7184). There are an additional 44 contractors with FY 1986 contracts valued at $16.6 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 2729, Chemical Defense. This project provides the technology to insure continued effectiveness of air operations and aeromedical care in the event of a chemical attack. It is fully coordinated with the Army as the lead Department of Defense agency for chemical defense. Project goals are to enhance USAF capabilities in seven functional areas: individual protection; collective protection; detection, identification and warning; contamination

control; medical operations; operations analysis for Air Force chemical and biological defense; protective drugs and their performance effects. FY 1986 accomplishments include: (1) validated ingress/egress procedures to maintain uncontaminated chemical defense collective protection shelters; (2) functional design of contamination control areas for medical chemical defense collective shelters; (3) conceptual designs for chemical defense ground crew respirators. In FY 1987, FY 1988 and FY 1989 human and animal studies will be continued in order to establish dose performance curves, possible drug interactions and long-term low dose effects for drugs that protect against chemical agents. Studies in FY 1987 will be specifically designed to test aircrew tolerance of the chemical defense pretreatment drugs including an in-depth look at pilot performance during flight tests. In FY 1988, investigations will concentrate on development and evaluation of methods to reduce the compounded physical and psychological stress resulting from use of chemical defense equipment during combat. In addition, chemical casualties estimates will be made for the NATO theatre. In FY 1989, a physiological and biochemical animal model will be developed to establish maximum acceptable chemical agent exposure limits. These limits will be used in combination with accumulated performance data to establish adequate protection factors and to develop generic design principles for improved integrated chemical defense ensembles and systems.

B. (U) Project: 6302, Occupational and Environmental Toxic Hazards in Air Force Operations. This project maintains sole research and development responsibility within the Air Force for the toxicological assessment of Air Force materials and processes. Assessment of human tolerance levels for USAF chemicals, fuels and materials is required in order to establish exposure criteria for engineering design of new systems as well as to perform trade-off analyses between weapon system performance and occupational health and environmental support requirements. FY 1986 accomplishments include: (1) specification of toxicity values and acute exposure limits for thionyl chloride, the electrolyte used in Minuteman III batteries; (2) verification in animals of the carcinogenicity of monomethol hydrazine, a space shuttle propellant; (3) specification of the dermal uptake rate of hydrazine, thereby illustrating exposure hazard despite respiratory protection; and (4) dermal, oral and inhalation toxicity of synthetic hydraulic fluid. Goals for FY 1987 include specification of toxicity levels for a variety of aviation fuels including JP-7, JP-TS and JP-8. In FY 1988, similar experiments will determine the toxicity of carbon slurries and shale derived JP-4. In FY 1989, work will continue on the Toxicokinetics Computer Simulation System, high energy fuels toxicity studies, and Volume III of the Installation and Restoration Toxicology guide which will emphasize groundwater contaminant mixtures.

C. (U) Project: 6770, Biotechnology Studies in Advanced Systems. This project supports efforts within the Aerospace Biotechnology program which affect all three laboratories within the Aerospace Medical Division. It specifically funds national scientific and technical organizations, committees and tri-service groups to advise the scientists supported by this program element and thereby insure high quality meaningful coordinated exploratory development efforts. This includes support to the Institute of Laboratory Animal Resources to serve as a coordinating agency and a national and international resource for compiling and disseminating information on laboratory animals; the National Academy of Sciences/National Research Council for workshops, symposia, and newsletters to provide a forum in which academic research scientists and aeromedical division scientists can interact; and the Department of Defense Human Factors Engineering Technical Advisory Group for tri-service coordination and review of programs and semiannual reporting to the Office of the Under Secretary of Defense for Research and Engineering on tri-service research, development and applications of human factors. This project also supports the Aeromedical Division's postdoctoral fellowship

program managed by the National Academy of Sciences. During FY 1986 the National Academy completed evaluations within the toxicology and neural science areas. These evaluations are extremely useful aids for restructuring laboratory programs. In FY 1987, FY 1988 and FY 1989 the National Academy will continue to evaluate relevant research programs for Aeromedical Division laboratories. Moreover the Division plans to expand its post doctoral program to include new and very relevent areas such as molecular genetics. This project will continue to support other technical advisory groups such as the DOD Human Factors Technical Advisory Group.

D. (U) Project: 6893, Manned Weapon Systems Effectiveness. This project develops techniques to deceive the operators of enemy air-to-ground and ground-to-air systems. Visual camouflage, optical countermeasures and techniques to fool infrared and radar sensors are developed, simulated in the laboratory, and field tested. In addition, a variety of studies of human visual capacities are performed. Measurement of enemy antiaircraft operator performance is accomplished with simulation and flight test. Blue forces countermeasures are developed and transitioned. The need for motion in both engineering and training simulation is explored, including the modeling of visual/motion effects on operator performance. FY 1986 accomplishments include: (1) successful flight test of a night vision head's up display; (2) determination that progressive myopia significantly reduces the percentage of Air Force Academy graduates who are qualified for flying training; and (3) qualitative assessment that pneumatic/hydraulic cushions adequately simulate gravity forces for simulator use. In FY 1987, FY 1988 and FY 1989 efforts will continue to specify (1) high payoff roles for military man in space including a definitive assessment of man's space to ground visual capability and (2) the technical basis and evaluation criteria for target masking and camouflage techniques based on human visual and cognitive processing. Specific FY 1987 milestones include: (1) measure the effects of ground-to-air and air-to-air laser weapons on the human visual system; (2) complete flight testing of airfield visual deception system; (3) quantify the effects of attack aircraft tactics on enemy system and aircraft operator visual tracking performance; (4) evaluate low cost simulator motion systems relative to their effect on operator performance and transfer of training; and (5) quantify blue force crew performance in the optical acquisition and tracking of air-to-ground and air-to-air targets. FY 1988 goals include the development of an enhanced optically based passive terrain avoidance system. FY 1989 goals include the development of a night side space visual performance system, and the initiation of a man-in-the-loop strategic threat adversary system simulation.

E. (U) Project: 7184, Man-Machine Integration Technology. This project develops procedures and technologies to improve the interface between human operators and electronic/mechanical systems. Information about the perceptual, cognitive and response characteristics of human operators is measured within mission specific scenarios to provide design data for system control and display development. Standardized methods are developed to measure and track the changes in weapon system performance as a result of changes in man-machine coupling. Natural interfaces are those which least distract the weapon system operator from the important part of his mission. FY 1986 accomplishments include development of: (1) a prototype command, control and communications crew station which has been optimized for human performance characteristics; (2) a one-fourth inch diameter cathode ray tube for use in helmet mounted display systems; and (3) a B-1B simulator to be used in-house for engineering design research and by Strategic Air Command for training. FY 1987 goals include: (1) design of B-52 crew station with night vision system compatibility; (2) develop windscreen distortion criteria for the B-1B to guide maintenance; (3) conduct assessment of B-1B crew interaction during simulated low level relocatable target attack; (4) complete wide field-of-view helmet mounted display technology demonstration for

the Light Helicopter Family (LHX) program; (5) conduct tactical air-to-air utility simulation of a helmet mounted display; (6) complete transition of prototype Command, Control and Communications workstation to NORAD; (7) publish a comprehensive air vehicle crew station guide and (8) develop an advanced night vision goggle heads-up display. FY 1988 will produce a B-1B defensive system display design, a prototype human engineering workstation incorporating practical Artificial Intelligence, and an on-line analysis system for Crew Station Ergonomics. FY 1989 goals include the completion of a virtual terminal for fighter battle simulation, a brassboard wide field-of-view Super Cockpit display system, and completion of a computer aided maintenance design system.

F. (U) Project: 7231, Safety and Aircraft Effectiveness in Mechanical Forces Environments. Efforts within this project determine human response to a variety of mechanical forces: noise, impact and sustained acceleration, and vibration. This information is needed for the development of safe, effective escape/ejection systems, acceleration protection equipment, and restraint devices for aircrews. The project also develops data for operator centered communications, communications jamming, and noise exposure criteria. FY 1986 accomplishments include: (1) the completion of an evaluation of environmental noise in a military operations area (Desert Memorandum of Agreement in Nevada), (2) the development of a mathematical model to assess the injury potential of helmet-mounted equipment, and (3) the development of an automatic sound-activated sonic boom analyzer/recorder for environmental impact surveys. The advanced dynamics anthropomorphic manikin, which allows for lifelike dynamic testing of advanced escape systems, will be completed in FY 1987. Other milestones in FY 1987 include the demonstration of a microphone capable of actively reducing interference from the high levels of noise which occur in airplane cockpits, and a test of ejection sequence and parachute inflation for the ACES II ejection seat under low speed low altitude conditions. In FY 1988 and FY 1989 resources will be shifted toward technologies to develop remote, closed loop control of mobile robots by human operators. The objective is to link human judgement, adaptability, and dexterity in real time to robots capable of operating in lethal environments.

G. (U) Project: 7755, Aerospace Medicine. The objectives of this project are to: (1) provide aeromedical research data that addresses medical selection and retention of operational aircrews; (2) investigate methods of early disease detection, and determine impact of these diseases on aircrew performance; (3) enhance aircrew visual performance by investigating physiological optics and ophthalmological criteria; and (4) determine effects of neurological and cardiological influences on aircrew performance. FY 1986 accomplishments include: (1) the development of assessment criteria for the evaluation of heart mitral valve prolapse in aviators and (2) initiation of the development of a night vision laboratory to provide data for new visual standards and new techniques to enhance aircrew vision, and to evaluate night vision devices for clinical and operational suitability. FY 1987 goals include the expansion of the Medical Imaging Computer Analysis System (MICAS). The purpose of MICAS is to store on a computer linked digital data base information from sound tomography, nuclear imaging and other clinical techniques for enhanced analysis and diagnostic prediction. Also, a study of contact lens applications in Military Airlift Command flight operations will be completed in FY 1987. FY 1988 goals include additional enhancements to the diagnostic software such as Emission Computed Axial Tomography and the development of medically approved new vision standards for aviators. FY 1989 goals are to integrate and analyze cardiological and other medical data presently residing in the Clinical Sciences data base, and propose new medical standards for acceptance and continuation for USAF aircrews.

H. (U) Project: 7757, Radiation Hazards in Aerospace Operations. This program assesses biological hazards, develops countermeasures and quantifies acute and delayed biological effects of radiofrequency, ionizing, laser, nuclear flash, and particulate radiation on Air Force personnel. It performs personnel hazard assessments, defines safe separation distances, develops protective devices, and develops the means to predict air and ground crews' ability to maximally perform in laser, radiofrequency or nuclear radiation environments. FY 1986 accomplishments include: (1) completion of a study of the bioeffects of long-term, low level radio frequency radiation; (2) publication of the Fourth Edition of the Radio Frequency Radiation Dosimetry Handbook; (3) summary of a 20-year study of radiation risk assessment for man in space; (4) evaluation of night glare produced by lasers on F-16 canopies; and (5) nuclear radiation exposure criteria for enduring missions. FY 1987 milestones include: (1) continued review of technology advances in nuclear weapons, (2) completion of the directed energy bioeffects laboratory; (3) field studies of high power microwaves; and (4) determination of radio frequency sensitivity of human and monkey endometrial cells. In FY 1988, a 20-year study of radiation exposure on primates will be completed. Extrapolation of biological effects of high power microwave from and animal models to man will be accomplished. In FY 1989, efforts will include bioeffects components of the Tactical Air Force High Power Microwave Program, ionizing radiation battlefield models, and laser bioeffects research in support of Tactical Air Command Statement of Need for Aircrew Ocular Laser Protection.

I. (U) Project: 7930, Advanced Crew Technology. This project develops design criteria and prototypes needed for improved protection of aircrews confronted by: (1) very high onset sustained G-forces, (2) spatial disorientation, (3) thermal extremes, (4) hypoxia, and (5) decompression sickness. Additional tasks involve the development and evaluation of aeromedical evacuation equipment and the evaluation and integration of life support equipment. In FY 1986, accomplishments include development of a $+G_z$ sustained acceleration protection model to assess protection methods developed for the Advanced Tactical Fighter. Laboratory testing of an advanced aircrew oxygen system was completed and transitioned for flight test. The major goal in FY 1987 is to develop a physiologically based $+G_z$ acceleration endurance/fatigue model. Another expected accomplishment is the development of a breadboard electromechanical oxygen regulator to replace the cumbersome pneumatic regulator now in use. In FY 1988 emphasis will be on the development and evaluation of advanced high altitude protection systems. For FY 1989, high altitude protection technologies will be integrated with an advanced development program for full pressure suits in order to determine the appropriate onset time and rate of inflation for Anti-G suits in response to very rapid onset acceleration.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 06MD, Aerospace Medical Division Laboratory Operations

A. (U) Project Description: This project provides the resources to conduct in-house research and development activities of the Aerospace Medical Division. These activities are predominantly conducted by specialized scientific teams using complex, unique research facilities and devices. The project provides for the pay and related costs of civilian physicians, scientists, engineers, and support personnel. It covers travel, transportation, rents, [illegible]cations, utilities, laboratory supplies, unique equipment, and other related costs needed to conduct [illegible]nology research and exploratory development. It also funds salary, travel and equipment for personnel at

Aeronautical Systems Division to provide procurement support to the Aerospace Medical Division.

B. (U) Program Accomplishments and Future Efforts: Not Applicable.

C. (U) Major Milestones: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62203F
DOD Mission Area: 523 - Engineering Technology (ED)

Title: Aerospace Propulsion
Budget Activity: 1 - Technology Base

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	58,352	59,723	71,233	69,733	Continuing	N/A
06PP	Laboratory Operations	20,053	19,365	21,411	21,844	Continuing	N/A
3012	Ramjet Technology	6,756	7,217	7,863	7,348	Continuing	N/A
3048	Fuels, Lubrication and Fire Protection	7,240	8,942	8,494	9,742	Continuing	N/A
3066	Turbine Engine Technology	15,905	15,659	24,496	22,470	Continuing	N/A
3145	Aerospace Power Technology	8,398	8,540	8,969	8,239	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element develops air breathing propulsion and aerospace power technology in support of current and future aerospace vehicles and weapons systems. Major emphasis is on achievement of high thrust to weight engines and technology for high Mach flight. Additional emphasis is being placed on advanced power technologies for space applications calling for 10-30 kilowatt power levels. Laboratory exploratory development and component/subsystem evaluations are conducted in the technical areas of turbine engines, ramjet engines, fuels, and lubrication technology as well as aerospace power generation, distribution, and control technology. The program also provides for the management and support of the Aero Propulsion Laboratory operations at WrightPatterson AFB, OH. This is a Science and Technology effort.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	63,297	65,552	68,415	N/A	Continuing	N/A

EXPLANATION: FY 1986 difference due to Gramm-Rudman-Hollings and undistributed cuts in FY 1986 Appropriations Bill. FY 1987 difference is due to Congressional action. FY 1988 adjustment reflects increased DOD emphasis on turbine engine research at exploratory development level. Increased funding level is necessary to maintain technological edge in turbine engine technology into the next century.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

Military Construction Funds	1,950	2,750	0	5,300	Continuing	N/A

5. (U) RELATED ACTIVITIES: This program receives information and basic technology from PE 61102F, Defense Research Sciences. Materials technology used by this program comes from PE 62102F, Materials. It provides component technology

and design methodology to PE 63202F, Aircraft Propulsion Subsystem Integration (APSI); PE 63211F, Aerospace Structures and Materials; PE 63216F, Aerospace Propulsion and Power Technology, and others. Coordination with Army, Navy, Defense Advanced Research Projects Agency (DARPA), National Aeronautics and Space Administration (NASA), Department of Energy, Department of Transportation, Environmental Protection Agency, industry and academia is accomplished by joint projects, information exchanges and standing committees such as Interagency Advanced Power Group, the Joint Army-Navy-NASA-Air Force Interagency Propulsion Committee, and NASA/Air Force semiannual meetings. In FY 1985 the Aero Propulsion Laboratory and Materials Laboratory began the High Performance Turbine Engine Technologies (HPTET) initiative which is supported by Projects 3048 and 3066. The HPTET initiative is an effort to provide the Air Force with the technology base necessary to enable full scale development of turbine engines with double the thrust-to-weight capabilities for all Air Force aircraft with an IOC of 2010 and beyond. In the interim technologies will become available for all derivative and new engine developments. Beginning in FY 1988, HPTET becomes part of the DOD/NASA IHPTET initiative which addresses the full spectrum of military aircraft turbo propulsion needs. The IHPTET initiative is also funded by 62102F, 63202F, 63211F, 63216F, 62209A, 63201A, 62122N, 62234N, and 63210N.

6. (U) **WORK PERFORMED BY:** Work is managed and performed by the Aero Propulsion Laboratory, Wright-Patterson AFB, OH. Other Air Force organizations involved are the Aeronautical Systems Division, Wright-Patterson AFB, OH; the Space Division, Los Angeles AFS, CA; and the Armament Division, Eglin AFB, FL. The five major contractors for the program are: General Electric, Evendale, OH and Lynn, MA (all projects); United Technologies, East Hartford, CT, West Palm Beach, FL and San Jose, CA (Projects 3066, 3012, 3048); McDonnell-Douglas Aircraft, St Louis, MO (Projects 3066, 3012, 3145); Garrett Corp, Los Angeles, CA and Phoenix, AZ (Projects 3066, 3048); and Boeing Co., Seattle, WA (Projects 3012, 3048, 3145). There are 70 additional contractors working on 70 contracts valued at $66,000,000.

7. (U) **PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR IN FY 1989:**

A. (U) Project: 3012, Ramjet Technology. This project develops airbreathing propulsion technology for future high speed aircraft, and missiles. Application of the technologies under development include: Combined Cycle Engines including Turboramjets and Air Turboramjets (ATRs) for aircraft and space vehicles; Scramjets (Supersonic Combustion Ramjets) for hypersonic aircraft; liquid fueled ramjets, ducted ramjets, solid fuel ramjets and ATRs for air-to-surface, air-to-air and other long range missile applications. The expansion of advanced propulsion technology for high speed aircraft applications is a major change from previous year and results in a deemphasis on missile technology. FY 1986 Program: A several year program to develop swirl combustion technology was completed, thus allowing a significant shortening in the length of ramjet burners. All basic work was completed on solid fueled Variable Flow Ducted Ramjet technology. This major milestone allows technology transition to Advanced Development and, ultimately, the development of air-to-air missiles with twice the current capability. Breakthroughs were achieved in Boron fuel formulation and Boron fuel combustion efficiencies for solid fuel ramjets, thus allowing a 50 percent or better range improvement over conventional liquid fueled ramjet missiles. Major efforts in advanced missile structures and aero-configured missile designs were begun. Studies of composite engines and scramjet engines were initiated. FY 1987 Program: Major efforts on turboramjets, air turboramjets, and scramjets will be initiated. The objective of this work is to dramatically expand the operational flight envelope for future aircraft (up to Mach 12). Analysis results will be made available and critical component experiments will begin. Development of advanced structures for ramjet

missile engines will allow a 30 percent reduction in missile engine weight. This advance, plus integration of the engine in an aerodynamically configured missile design, will allow revolutionary improvements in missile effectiveness. Programs to exploit Boron fuels will be emphasized in the Solid Fuel Ramjet area. FY 1988 Program: Tests of Scramjet engine critical components will provide a basis for future engine development efforts and vehicle designs. Turboramjet and air turboramjet designs will be initiated based on the completion of analysis and initial component work. Advanced structures work for missile engines will be completed and transitioned to advanced development or field applications. Revolutionary ducted ramjet technology will be initiated to allow greater altitude excursions (greater throttle ratio) and use of higher energy fuels. Boron fuel development for solid fuel ramjets will be completed and an engine design and demonstration program begun. FY 1989 Program: Scramjet and composite engine component experiments will be completed and will provide the basis for decision on continued development. A follow-on scramjet engine program will be initiated to capitalize on prior experimental results. This effort will provide a definitive assessment of the utility of scramjet propulsion for advanced traditional aircraft applications (fighter, strategic recon, and interceptor). Aero configured missile designs will be completed and transitioned to system developers. The Boron solid fuel ramjet demonstration effort will yield results of component testing.

B. (U) Project: 3048, Fuels, Lubrication and Fire Protection. This project provides: (1) improved Air Force fuels and the understanding of fuel/system capabilities required to support present and future airbreathing engine powered weapon systems; (2) lubricants, lubrication techniques, condition monitoring techniques, and lubrication system components (bearings, seals, dampers) to satisfy the stringent requirements of future aerospace weapon systems, and (3) advanced fire and explosion hazard characterization methodology, fire prevention and containment measures, hazard detection, and active and passive protection systems to satisfy flight vehicle combat survivability and operational safety requirements. This project supports the Aero Propulsion Laboratory/Materials Laboratory High Performance Turbine Engine Technologies (HPTET) and DOD/NASA Integrated High Performance Turbine Engine Technologies. Additionally, this project supports other Air Force commands in resolving operational system problems and coordinates the research, development, test, and evaluation of Air Force fuels, lubricants, and specialty fluid products for airbreathing propulsion and power systems. The project is divided into five major emphasis areas: aviation fuels, missile fuels, lubricants, bearings, and fire protection. Fire protection subsystem technology efforts are being deemphasized in FY 1987. FY 1986 Program: Fuel development and evaluation programs continued, with the characterization of high density fuels produced from a variety of sources. The potential of new fuels such as endothermics was assessed for hypersonic system applications. A breadboard carbon slurry fuel system for long-range cruise missiles has been demonstrated. A ramjet boron solid fuel, which has 70 percent more volumetric energy than the current baseline hydrocarbon fuels, has been developed in conjunction with efforts under Project 3012. Research efforts have been redirected toward development of an improved lubricant with 400°F capability to meet Advanced Tactical Fighter engine requirements. Effort to develop a solid lubricated ball bearing for expendable turbine engines began. The service evaluation of the portable engine wear metal analyzer was completed and the instrument is being purchased by Air Force Logistics Command for field use. An assessment of bearing/lubrication requirements necessary to achieve HPTET goals was begun. FY 1987 Program: Endothermic fuel studies will be continued to determine the potential of using such fuels in hypersonic applications. Advanced high energy chemicals will be evaluated for potential use in advanced weapon systems. A new program will be initiated to measure the subsonic and supersonic combustion performance of new advanced fuel candidates. These efforts are needed by system designers to design fuel systems and combustors for

advanced systems. In early FY 1987, a program dealing with solid-lubricated roller bearings for man-rated engines will be started. This program will build on the results for the ball bearing program for limited life engines. Lubricant standardization and support requirements will continue. FY 1988 Program: Advanced fuels development will be continued. Major emphasis of the lubricants and bearings programs will be directed toward High Performance Turbine Engine Technologies (HPTET) requirements. A program to test candidate lubricants capable of operating between -60°F and 400°F will be initiated late in FY 1988. The development program on small, solid lubricated ball bearings for limited life engine systems will be completed. Solid lubricated roller bearing development will be continued. The analytical effort to identify lubrication needs for HPTET will be completed and will provide the basis for defi ning specific programs. A small-scale HPTET, small cruise missile engine size lubrication system simulator development effort will be initiated to evaluate small volumes of experimental lubricants along with advanced bearings (including magnetic bearings and seal development programs. FY 1989 Program: Fuels and Lubrication programs will continue to be principally directed towards HPTET and combined cycle engine technology and system needs. Laboratory-scale subsystem engineering assessment of promising high heat sink, advanced endothermic fuel candidates will be initiated. Concurrently, a program will be begun to develop ignition delay and combustor kinetic models to complement the ongoing efforts to measure the combustion performance and fuel atomization and mixing of candidate high Mach fuels using advanced combustion diagnostics. Development of several high temperature test devices for performance validation of advanced liquid and solid lubricants bearings and lubrication system materials will be completed. A program will be initiated to develop an advanced lubrication system simulator for evaluation of full-scale lubrication system components under projected HPTET environments. Research and development on new bearings and seals--including definition of the potential for using magnetic bearings for high temperature engine systems and long-life cyrofuel pump bearings for combined cycle engine and advanced aerospace plane applications--will be continued.

C. (U) Project: 3145, Aerospace Power Technology. This project supports development of solar power, fuel cells, batteries, hydraulics, power conversion, conditioning and transmission devices, and thermal management technology for both space and atmospheric flight vehicle applications. These analytical and experimental efforts form a balanced, broad aerospace power subsystem technology base. Current goals include increased power output, decreased weight and volume, decreased vulnerability, increased life and reliability, and increased environmental tolerance for future systems. Approximately 50 percent of the effort supports space power requirements. FY 1986 Program: Completed design of a high temperature, Variable Speed Constant Frequency electrical generator system; demonstrated high temperature capacitors and an experimental hot gas auxiliary power unit high temperature starter motor. Exploratory development of a low cost and reliable lithium battery was completed. An additional high energy density space battery effort was initiated with emphasis on sodium sulfur battery system. FY 1987 Program: Fault tolerant aircraft electrical system research and development will continue toward a demonstration in FY 1988, including the application of Very High Speed Integrated Circuitry (VHSIC) technology to improve reliability and power density. A program to demonstrate a multi-bandgap solar cell, with more than 50 percent improved power output, will be initiated. Sodium sulfur space battery and high power density missile battery programs will be continued. The low profile hydraulic actuator program for thin wing aircraft will be continued. A study will be initiated to define power technology gaps for high Mach vehicles. Thermionic energy conversion research will be initiated. FY 1988 Planned Program: A high temperature hydraulic seal program will be initiated. The fault tolerant electrical system program will be completed. The application of VHSIC technology development will continue into the aircraft electrical system program will be continued.

The high Mach vehicle power systems study will continue. The multibandgap solar cell program will be continued. Thermionic converter technology and advanced heat pipe radiator programs will be initiated. FY 1989 Program: The major new effort will be development of technology necessary for ultra lightweight, high power solar arrays needed to support advanced space systems. The low profile actuator program will be completed. The high temperature hydraulic seal program will be continued. The space foil bearing program will be completed. The high power density missile battery development will continue. This project develops the nonnuclear power technology base for Air Force systems and is coordinated with the Strategic Defense Initiative Organization to ensure that there is no duplication of space power efforts.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3066, Turbine Engine Technology

A. (U) Project Description: The purpose of this project is to conduct exploratory development on advanced turbine engine component technologies to provide superior turbopropulsion and combined airbreathing propulsion systems for future manned and unmanned aircraft applications. This project develops technology to increase propulsion system operational reliability, mission flexibility, and performance while reducing fuel consumption, weight, and cost. Both analytical and experimental efforts are conducted in fans and compressors, high temperature combustors, turbines, seals, controls, diagnostics, exhaust systems, and structural design. This project considers the total propulsion system (inlet, engine, nozzle) and its integration into a weapon system. A large portion of this project (60-80% of available resources) will be in support of the High Performance Turbine Engine Technology (HPTET) program a joint Aero Propulsion/ Laboratory technology development initiative. The goal of HPTET is to integrate efforts to provide, by the year 2000, the technology necessery to double turbine engine capability (e.g., 20:1 thrust-to-weight ratio fighter engine). These technologies will transition to the Aircraft Propulsion Subsystem Integration (PE 63202F) and Advanced Turbine Engine Gas Generator (PE 63216F, Project 681B) efforts for validation and advanced development. (Beginning in FY 1988 this project, including HPTET will be in direct support of the DOD/NASA Integrated High Performance Turbine Engine Technology (IHPTET) program, a DOD/NASA technology development initiative).

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Concentrated efforts continued on component development, advanced heat transfer concepts, and structural/meterial innovations. More than 50% of this project was in support of the HPTET program. Accomplishments of particular significance included the successful fabrication of a high specific modulus titanium metal/matrix composite shaft, a design which will permit fewer bearings and a simplified lubrication system. The results of this work will contribute directly to the goals of HPTET. Likewise, recent advances in computational fluid dynamics have made it possible to analyze the effects of unsteady interactions (wakes, shocks, pressure waves) on the performance and cooling efficiency of turbine airfoils--vanes and blades. In addition, emphasis was placed on the in-house development and implementation of a new turbine heat transfer and cooling research program to provide bench mark, high quality experimental data in the areas of turbine vane and blade heat transfer, cooling air distribution and turbine airfoil aerodynamics. Preliminary test facility design and necessary equipment layout was completed

and a detail design contract was established. In support of the Expendable Turbine Engine Concepts program for potential future supersonic missile propulsion, technology development continued for high temperature (2400°F+) hot section components (carbon-carbon, ceramic combustors, and cooled turbines) and for advanced compressors. High Performance Turbine Engine Technology (HPTET) efforts initiated in FY 1986 include a enhanced flow compressor development for high Mach (up to Mach 6) turbine engines, and an advanced high-work turbine development for intermediate (15:1 class) thrust-to-weight levels. A composite blade/disk attachment and interface effort will be completed.

(2) (U) FY 1987 Program: Efforts to be completed include vane/blade interaction programs modeling the aerodynamic and heat transfer coupling between a cooled turbine vane and blade in a high-temperature gas path environment. Complementing this work will be the Turbine Cooling System Design Program which provides advanced turbine heat transfer technology for improved film cooling. Programs on composite disk life prediction, hot section component development for limited-life missile propulsion applications, and optimized control will also be completed. A number of ongoing and planned programs dealing with the development and application of advanced, innovative, nonintrusive instrumentation will be conducted to support increasing requirements for accurate, reliable engine and component stress/strain, temperature and pressure data. Ongoing and planned compressor, combustor, and turbine component design system developments incorporating complex 3-D aerodynamics, composite structure stress predictions, and advanced heat transfer codes will depend heavily on the successful application of these new measurements for effective computer prediction model code validation. In addition, the initial study phase of the enhanced flow compressor for the high Mach turbine engine will be completed, from which ultimate program direction, payoff and key technology requirements will be defined for both manrated and limited-life systems. Subsequent program phases will be based on results from this initial study. A number of HPTET efforts will be initiated in FY 1987, including an exoskeletal structural design, an advanced concept compressor development for intermediate HPTET goals (FY 1992), a lightweight controls development, a nonmetallic design methodology for turbines, and a secondary flow program on active clearance control. All of these exploratory development will transition to the Aircraft Propulsion Subsystem Integration (PE 63202F) and Advanced Turbine Engine Gas Generator (PE 63216F, Project 681B) for advanced development.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: During FY 1988, a major portion of the project 3066 budget allocation will be dedicated to demonstrating and maturing competitive Integrated High Performance Turbine Engine Technologies (IHPTET) component technologies for subsequent transition to the Advanced Turbine Engine Gas Generator program (PE 63216F, Project 651B). Specifically, major emphasis will be placed on ongoing compressor, combustor, turbine and innovative structural design efforts leading to interim component and engine demonstrations, for application in the early 1990s. The following technical issues will receive priority attention in support of HPTET: (1) damage tolerant, very high temperature composites and fiber reinforced engine structures; (2) near-stoichiometric hot section designs; (3) damage tolerant Titanium Aluminide metal matrix composites; (4) compact hi-flow compression systems; (5) multifunction lightweight controls/accessories; and (6) hi-temperature metal alloys and refractory materials. Within the compressor area, two significant technology demonstrations will occur in FY 1988 using the laboratory's Compressor Research Facility--(1) initial performance characterization of a full-scale HPTET compressor and (2) multi-stage performance and matching of swept-rotor aerodynamics. HPTET efforts to be initiated include a high temperature combustor development program a lightweight exhaust nozzle structure, development of an advanced engine control engine control architecture, high temperature abradable seals, and low leakage seals. HPTET efforts to

be completed include the Advanced Concepts Compressor design, the advanced rotordynamics program, and heat transfer in large turbines. Programs will be initiated in Integrated Control Law Evaluation--Model Validation, Hi-Energy Fueled Turbine (cryogenics and endothermics), combustion turbulence and swirler aero research.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Again in FY 1989, the Project 3066 budget allocation will be dedicated to the continued demonstration and maturation of competitive High Performance Turbine Engine Technologies (HPTET) component technologies for subsequent transition to the Advanced Turbine Engine Gas Generator program (PE 63216F, Project 681B). Specifically, major emphasis will continue to be placed on ongoing compressor, combustor, turbine, and innovative structural design efforts leading to interim component and engine demonstrations for application in the 1990's. The following technical issues will continue to receive attention in support of HPTET: (1) damage tolerant, very high temperature composites and fiber reinforced engine structures; (2) near-stoichiometric hot section designs; (3) damage tolerant titanium aluminide metal matrix composites; (4) compact hi-flow compression systems; (5) multi-function lightweight controls/accessories; and (6) high temperature metal alloys and refractory materials. During FY 1989, a number of technical accomplishments/demonstrations within the HPTET hot section area are expected: (1) validation of the HPTET combustor dome/flow-path design; (2) characterization of a nonmetallic combustor liner for high temperature operation, and (3) development of an advanced heat transfer design system for large man-rated turbine applications. HPTET efforts to be initiated will be defined consistent with the progress made and with the HPTET program plan. Specific efforts will be development of an advanced fan and low pressure turbine design, high temperature structural instrumentation, and hot section performance characterization using alternate fuels (to include cryogenic and endothermic fuels for high Mach propulsion system application). Efforts to be completed include the Advanced Turbine Rotor Design program, the Advanced Thermographic Phosphors program, the Compressor Stage Matching Investigation and Test program, and the Advanced Exhaust Nozzle Cooling Concepts program. Ongoing contracts include completion of the new Turbine Research Laboratory, Compressor Research Laboratory, Turbo-structures Research Laboratory aeromechanical research support, and advanced component design system developments.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not applicable.

9. (U) PROJECT OVER $10 MILLION IN FY 1988/AND OR FY 1989:

(U) Project: 06PP, Laboratory Operations

A. (U) Project Description: This project provides for the support activities required to operate the Aero Propulsion Laboratory at Wright-Patterson Air Force Base, OH. The Laboratory provides technical support to current and future systems programs and undertakes operational support projects in its mission areas. The project provides for the pay and related costs for civilian employees, travel, transportation, rents, communications and utilities costs, and procurement of supplies. It also funds salaries, travel, and equipment for personnel at Aeronautical Systems Division providing procurement support to the Laboratory.

B. (U) Program Accomplishments and Future Efforts: Not applicable.

C. (U) Major Milestones: Not applicable.

10. (U) COOPERATIVE AGREEMENTS: Not applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62204F
DOD Mission Area: 521 - Electronics and Physical Sciences (ED)

Title: Aerospace Avionics
Budget Activity: 1 - Technology Base

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987* Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		57,445	61,959	65,975	73,073	Continuing	N/A
06AA	Air Force Avionics Laboratory Operations	29,275	30,982	31,804	32,352	Continuing	N/A
2000	Active Electronic Countermeasures	2,651	2,947	3,290	4,005	Continuing	N/A
2001	Electro-Optical Technology	1,980	2,200	2,460	2,995	Continuing	N/A
2002	Microwave Technology	4,655	5,175	5,780	7,035	Continuing	N/A
2003	Avionics System Design Technology	4,426	4,580	4,700	4,850	Continuing	N/A
2004	Technology for Reconnaissance and Targeting Avionics	2,101	2,335	2,605	3,170	Continuing	N/A
6095	Inertial Reference and Guidance Technology	969	1,080	1,206	1,470	Continuing	N/A
6096	Microelectronics Technology	2,932	3,260	3,640	4,430	Continuing	N/A
7622	All-Weather Reconnaissance/Strike Avionics	3,998	4,445	4,960	6,035	Continuing	N/A
7629	Fire Control Avionics	1,666	1,850	2,065	2,515	Continuing	N/A
7633	Passive Electronic Countermeasures	2,282	2,540	2,835	3,450	Continuing	N/A
7662	Avionics Data Transmission and Reception	510	565	630	766	Continuing	N/A

*Subsequent to submission of the R-1, $1.8 million has been reprogrammed into the program element bringing the total to $61.959 million for FY 1987.

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Science and Technology program is the primary source of new concepts, feasibility demonstrations, and technology evaluation for Air Force avionics system needs. It develops needed avionics technology for target detection and classification, fire control, navigation, communication, jamming and deception of hostile defenses. Avionics system design and avionics subsystem integration technology and the supporting technology of electronic devices and circuits are also developed. Avionics advances are needed to multiply weapon system effectiveness and yield enhanced reliability and reduced life cycle costs. The program also supports the management and support of the Avionics Laboratory, Wright-Patterson Air Force Base, OH.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	71,204	67,826	78,083	N/A	Continuing	N/A

EXPLANATION: (U) Difference in FY 1986 reflects reductions because of small business innovative research program and Gramm-Rudman-Hollings, and loss of reprogramming action to add $10 million to PE. Net difference in FY 1987 reflects Congressonal reduction, inflation adjustment and addition of $1.8 million to increase funds for high payoff optical-electronic technology. Difference in FY 1988 reflects change to Air Force total obligation authority.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: This program is a broad technology base effort, and technology is exchanged between a large number of related program elements. The most significant are: Defense Research Sciences, 61101E; Defense Research Sciences, 61102F; Materials, 62102F; Strategic Technology, 62301E; and Command, Control, and Communications, 62702F. Technology is further refined and demonstrated in related advanced development programs: Advanced Avionics for Aerospace Vehicles, 63203F; Very High Speed Integrated Circuits, 63452F; Advanced Integration Avionics, 63253F; and Integrated Electronic Warfare System/Integrated Communication Navigation Identification Avionics Advanced Development, 63109F. All electron device work is coordinated through the Advisory Group on Electron Devices which advises the Office of the Under Secretary of Defense for Research and Engineering. Developments in thermal imaging and image processing are coordinated through the Night Vision Technology Panel under the Joint Deputies for Laboratories Committee of the Joint Logistic Commanders. Many areas are coordinated through the Air Force/National Aeronautics and Space Administration Interdependency Working Groups on Space and Aeronautics. Radiation hardening activities are coordinated through the Radiation Hardened Electronics Technology Coordinating Group. Infrared sensor developments are coordinated through the Joint Technical Coordinating Group on Thermal Imaging Sensors. The Avionics Laboratory participates in a Joint Air Force/Navy Radar Working Group, a Tri-Service Airborne Displays Working Group, and a Tri-Service Background and Targeting agreement headed by the Air Force Armament Laboratory.

6. (U) WORK PERFORMED BY: The Avionics Laboratory, Wright-Patterson Air Force Base, OH, manages the work performed under this program. The five major contractors are: Texas Instruments, Dallas, TX (2000, 2002, 2004, 6096, 7622); Hughes Aircraft Company, El Segundo, CA (2000, 2001, 2002, 2004, 6096, 7622, 7629, 7633); Environmental Research Institute of Michigan, Ann Arbor, MI (2003, 2004, 7622); Georgia Institute of Technology, Atlanta, GA (2000, 2002, 2003, 7622, 7633); and Raytheon Corporation, Bedford, MA (2002, 7622). There are 71 additional contractors with contracts valued at $116 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. Project: 2000, Active Electronic Countermeasures. Enemy air defense systems now use sophisticated methods of fire control, are very high in number, and use an ever-increasing portion of the electromagnetic spectrum including the visible regions. This growth in threat capability requires the demonstration of new aircraft to penetrate, accomplish mission objectives, and survive. This project addresses this need.

FY 1986

Accomplishments: The capability to point a laser beam over a 4 kilometer range and to correct for atmospheric turbulance using nonlinear optical technology was successfully demonstrated. A wideband high power (1-watt) monolithic microwave integrated circuit module for electronic warfare application has been demonstrated.

Monolithic microwave integrated circuit modules and solid state arrays will help improve the performance, capability and reliability of electronics countermeasures (ECM) systems.

FY 1987 Program: A program will be initiated to significantly expand the current data base of high power microwave effects on electro-optical and radio frequency systems. The closed loop infrared countermeasures system will be improved to give a faster system response time and to address the characteristics and susceptibilities of advanced infrared missile seekers. This is a joint Air Force-Navy development program.

Breadboarding of the most promising concepts will be built and tested.

Work will continue in the development of digital radio frequency memories that will be less susceptible to noise. Alternate methods for analog signal processing, including acoustic charge transport devices, will be initiated to provide lower cost and improved capability systems to the Air Force. FY 1988 Planned Program:

Field tests will be accomplished at various government facilities to evaluate the effectiveness of the developed during the last fiscal year.

In-house work will continue on methods and applications of artificial intelligence for electronic warfare applications to optimize ECM waveforms against a variety of threat systems.

FY 1989 Planned Program:

Efforts will be continued to perfect concepts and system design for expendable, multi-spectral countermeasures devices including simulation and testing to evaluate a variety of approaches. Advanced techniques for integrating gallium arsenide monolithic amplifiers into phased array antennas will be under development to provide improved power output, bandwidth and beam characteristics.

B. (U) Project: 2001, Electro-Optical Technology. This project develops low and medium power lasers, optical signal processing, and detector and focal plane array technology for target location, countermeasures, imaging, warning, tracking and weapon delivery functions. The payoff will significantly enhance performance with respect to increased range, variety of targets that can be detected, target resolution, and reliability for the avionics system functions cited above. FY 1986 Accomplishments: A modular, compact carbon dioxide laser at 10 watts of average power passed environmental tests in a flight qualifiable package, establishing the basis for future laser radar applications. New solid state laser materials are under study to quantify increases in efficiency, wavelength agility and reliability of lasers used in optical search and track, countermeasures, and weapon delivery functions. On-focal plane array signal processing techniques are being tested for transfer to follow-on sensor development projects. Demonstration of a solar

blind solid state ultraviolet detector and an ultraviolet photocathode has been completed and have improved performance over present devices. FY 1987 Program: Development of monolithic, low noise, modulated gallium arsenide (GaAs) laser diodes for application to a command signal link for millimeter wave phased array radar antennas will be started. A three terminal optoelectronic development based on heterojunction structures will be started. Payoff is speed and optical switching for use in optical signal processing. Development of an improved frequency shifter for inertial grade fiber optic gyros will be started. Fabrication and test of a multi-element heterodyne detector array for laser radar will be completed. These efforts will allow for improvements in navigation and radar processing. FY 1988 Planned Program: Demonstration of a high power, diffraction-limited semiconductor source using coupled channel coherent array technology for optical signal processing will be completed. A compact, medium power carbon dioxide laser using coupled waveguide cavities for extended range optical radar will be demonstrated. Development of a nonlinear infrared modulator for medium to high power levels will be completed. The initial feasibility phase of gallium arsenide optical waveguide development, optical signal processing and interconnect functions will be completed. Experimental optimization of long wavelength structured detectors will be completed. Gallium aluminum arsenide charge coupled device ultraviolet detector work for applications requiring solar blind receivers will be started. FY 1989 Planned Program: A low noise neodymium laser oscillator using phase conjugation for improved beam quality, and a gallium arsenide (GaAs) low noise oscillator initiated in FY 1987 will be fabricated. A three-terminal optoelectronic array in GaAs will be demonstrated. Primary new starts include efficient thin second harmonic generation materials, planar network technology based on GaAs waveguide baseline, and efforts on laser hardened focal plane arrays. An initial feasibility study of uncooled mercury cadmium telluride detectors will begin, and work on both carbon dioxide and tunable laser sources will continue. Fabrication of long wavelength, infrared superlattice detectors will be initiated, and radiation hardened long wavelength infrared detector arrays coupled with hardened silicon readouts will be demonstrated.

C. (U) Project: 2002, Microwave Technology. This project develops the technology required to produce, control, and apply microwave and millimeter wave power. The scope of efforts includes theory, techniques, devices, circuits, and array/system concepts at frequencies below 300 Gigahertz (GHz). Areas of development are solid state sources and amplifiers, thermionic devices, power sensing and control, and phased array antenna techniques. System applications for this technology include radar, electronic countermeasures, and communications. This technology development will increase reliability and performance, and reduce size and cost of components vital to a variety of microwave and millimeter wave systems. FY 1986 Accomplishments: Improvements continue to be made in power generation and amplification from solid state devices. Three hundred thirty watts peak power and 230 watts continuous power were demonstrated by static induction transistors at ultra high frequencies. Thirty watts continuous power was attained from GaAs field effect transistors (FET) at 5 GHz. These improvements are necessary to support radar, communication, and electronic warfare systems. In the thermionic source area, one hundred watts output power has been demonstrated in a 20-40 GHz traveling wave tube. Advances continue to be made in microwave and millimeter wave discrete devices and integrated circuits. A single chip monolithic transmit/receive module has been demonstrated at X-band frequencies. A 94 GHz coherent transmitter/receiver, that produced 40 watts peak power and makes use of hybrid integrated circuits for the receiver, was developed. These improvements are needed to support applications in radar, electronic warfare, and smart weapons. System studies have been completed for a 10 inch diameter 500-550 element multifunction solid state array which operates over the 4.5-18.0 GHz band to perform a multitude of radar and Electronic Countermeasures functions. Study results support the premise that multiple time shared small arrays can provide the requisite performance.

Significant progress has been demonstrated in X-band monolithic low noise receivers and power amplifiers. The resultant circuits are already being used in module validation work for application in future radar systems. FY 1987 Program: Thermionic tube work will continue to address low cost wideband high power millimeter wave developments. Gallium arsenide device/circuit work will be initiated to facilitate low cost large circuit fabrication. Novel circuit studies and experimental development will be started to exploit integrated microwave-optical components and array feed networks, and for nonreciprocal solid state circuits, such as circulators and isolators. These efforts will help improve system performance. High power deployable antenna techniques will be explored. The FY 1987 program will continue to address current problems such as monolithic circuit feasibility and cost reductions. FY 1988 Planned Program: Solid state source and amplifier programs will continue to address microwave and millimeter wave transistor development. Thermionic source work will concentrate on millimeter wave tubes for electronic countermeasures (ECM) applications. Techniques for improving reliability and performance of microwave tubes and novel high power microwave source technology will be emphasized. New efforts will be started to demonstrate ruggedized ECM tubes and fast wave 94 Gigahertz (GHz) power tubes. Monolithic circuit work will continue with new programs being initiated in both the microwave and millimeter wave frequency regions. Emphasis will be placed on developing integrated circuits with increased circuit function complexities and improved fabrication yield. Investigations of microwave-digital and microwave-optical circuits on the same chip will conducted. The multi-octave feed network which operates over the 4.5-18.0 GHz band will be completed in preparation for FY 1988 advanced development for a full scale 500 element 10 inch multifunction array. High efficiency X-/Ku-band power amplifier development will continue throughout this fiscal year for application in radar systems. FY 1989 Planned Program: Thermionic tube work will continue to address ruggedized electronic countermeasures tubes, novel high power microwave source technology, and millimeter wave power tube development. These efforts will have payoff in improved performancce, system reliability, and greater application in radar and electronic warfare systems. New solid state source and amplifier programs will address microwave and millimeter wave transistor development with emphasis on novel high yield device growth methods and wideband high power amplifier performance. Advanced wideband microwave and millimeter wave monolithic integrated circuit technology will be developed which will support the need to meet reduction in size and improved system performance and reliability. Complex digital-microwave-optical monolithic integrated circuit components will be demonstrated. Development of phased array feed networks using optical frequency beam forming and scanning will be initiated to reduce volume and simplify pattern control. High power microwave antenna development will be accelerated for tactical vehicle deployment.

D. (U) Project: 2003, Avionics System Design Technology. This project develops advanced technology for design, integration and validation of avionics information and display systems with special attention on improved component reliability, reduced system development costs and pilot/vehicle interface issues. Project goal is to enable fully integrated crew stations and significant improvements in a pilot's knowledge, situation awareness, and the aircraft/weapon system management. FY 1986 Accomplishments: A technology baseline for the Strategic Computing Initiative/Pilot's Associate program was successfully demonstrated with a prototype Crew Station Information Management expert system. A new heads up display illumination scheme using two-thirds less power, providing tenfold increase in reliability and no increase in size was conceived. A numerical stereo camera was delivered to the Johnson Space Center to support the measuring of astronauts under space conditions. A baseline interactive Ada workstation which increases programmer productivity twofold was demonstrated. A design of a generic signal processor capable of supporting widespread avionic requirements (i.e., radar, electronic warfare, integrated communications-navigation, image

processing) and which minimizes software difficulties and hardware costs and takes full advantage of Very High Speed Integrated Circuit progress was completed. FY 1987 Program: A man-in-the-loop simulator which integrates head up displays, head down displays, together with helmet mounted sights and uses the entire cockpit instrument panel as a display surface in combination with advanced touch panel and voice activated controls, will be delivered for in-house laboratory use and pilot testing. Expert system technology, as applied to pilot-aiding, will be expanded to include adaptive learning systems. A study report detailing technical approaches to provide brighter, significantly larger full color flat panel displays will be completed. An advanced graphics avionics display system brassboard capable of simultaneously generating three full color complex displays in real-time will be delivered in one-tenth the package size available from today's commercial products. A system capable of generating out-the-window forward looking infrared and synthetic array radar displays from a correlated database will be delivered. An enhanced Ada interactive workstation providing increased software reusability will be delivered and demonstrated. New starts are knowledge engineering database and learning systems development for pilot-aiding; application of machine intelligence for the automatic systems developments for pilot-aiding; application of machine intelligence for the automatic control of aircraft sensors; and the development of a high brightness, high contrast, large viewing area, full color flat panel display brassboard. FY 1988 Planned Program: Research will continue in cockpit display technology emphasizing the development of a large area, full color, head down flat panel display and biocybernetic workload evaluator so situation awareness information presented to the pilot is based on his current workload. Efforts initiated in FY 1987 for knowledge engineering database and learning systems developments for pilot-aiding will continue. Development of a signal processor with a tenfold increase in speed for airborne applications through the application of Gallium Arsenide (GaAs) will be initiated. Application and development of machine intelligence technology toward the realization of man-machine synergistic environments will continue emphasizing avionics software engineering, automated design of expert systems, adaptive processor, and cognitive processing techniques. FY 1989 Planned Program: A heads up display using two-thirds less power and providing a tenfold increase in reliability and a 10X10 inch full color flat panel display will be completed. Research will continue on the cockpit display technology and expand to initiate the development of three-dimensional dynamic holographic and full color display technology to provide pilot spatial orientation for air-to-air combat. In-house crew station evaluation to demonstrate and verify pilot-aiding and display concepts for pilot/vehicle interfaces will be emphasized. Research will continue for the development of a GaAs signal processor and expand to include Reduced Instruction Set Computer and parallel processing concepts. Investigation will be initiated for integrated airframe/electronics modules for reduced maintenance and life cycle costs. Feasibility of adaptive and cognitive processing techniques will be established.

E. (U) Project: 2004, Technology for Reconnaissance and Targeting Avionics. This project seeks to improve performance of reconnaissance, target acquisition, weapons delivery, and pilotage by advancing the capabilities of electro-optical and infrared sensors. Such improvements are required for successful use of low-altitude, high-speed tactical aircraft and cruise missiles in a battlefield environment. These improvements will provide increased numbers of target kills per aircraft pass over the target area, decreased pilot workload, increased pilot/aircraft survivability, and a stealthy target/weapon delivery capability. FY 1986 Accomplishments: Fabrication was completed of a single thermal imaging infrared sensor that can perform the missions of several specialized sensors - namely pilotage, target acquisition, and weapons delivery. Investigation continued on a novel new technique for passive infrared imaging which promises the potential for a dramatic increase in image detail for improved target assessment and discrimination

over existing systems. Investigation was started on the feasibility of further combining the functions of several sensors into one sensor, including air-to-ground targeting, air-to-air targeting, pilotage, air-to-air identification beyond the range of visible sight, and warning of approaching missiles. This sensor fusion approach will result in hardware reduction and improve overall system performance. Additional hardware and software were procured to continue in-house measurements to characterize the laboratory performance and field test advanced thermal infrared imaging sensors. FY 1987 Program: A preliminary demonstration experiment of a new imaging technique will be conducted to determine the increased imaging capability in one dimension. The combined sensors programs started in FY 1986 will be completed and transitioned into advanced development. Advanced algorithms will be initiated to improve performance of automatic target recognizers currently in advanced development which will assist the pilot in the real-time selection of appropriate weapons for the ground targets. Investigation will start on the use of electronic stabilization to reduce the amount of image blurring caused by aircraft vibration and atmospheric turbulence around the aircraft. FY 1988 Planned Program: Development will begin on a sensor employing the new imaging techniques (based on progress in FY 1986 and 1987) to determine increased imaging capability. Payoff is improved target detection and identification. Investigation will begin on the feasibility of near real-time computer optimization of infrared sensor focal plane array performance using artificial intelligence models for methods currently used by an experienced test engineer to optimize performance. Payoff will be decreased test time and improved reliability. FY 1989 Planned Program: Efforts will be initiated to explore the realm of target, background and weather which could yield new techniques for target discrimination with electro-optical sensors and target recognizers. Efforts will be completed on the use of electronic stabilization to reduce the amount of image blurring with payoff in target detection and identification.

F. (U) Project: 6095, Inertial Reference and Guidance Technology. The objectives are to improve the accuracy of inertial navigation systems/sensors for aerospace vehicles, cruise missiles and tactical strike weapons; develop integrated airborne antenna apertures for Communication, Navigation, Identification (CNI) systems; and to develop integrated reference systems concepts and architectures for improved mission capability. This includes precision low cost strapdown laser gyros, feasibility analysis and critical technology demonstrations of integrated CNI antenna apertures with low radar cross section and the exploitation of artificial intelligence techniques for integrated navigation system designs. These efforts are essential for improved weapon system mission effectiveness, supportability and low cost. FY 1986 Accomplishments: Demonstrated, through laboratory simulation, the initial practicality of applying artificial intelligence techniques of an Adaptive Tactical Navigation System for reduced pilot workload and increased mission accomplishment. A baseline method of integrating numerous navigation aids was developed. Development was initiated on an integrated CNI antenna aperture for 2-2000 Megahertz operation to reduce the number of antennas which will reduce radar cross section. The development of two innovative ring laser gyro concepts for reduced size and power were initiated. Development was initiated in computational techniques and structures that will enhance the robustness and reliability of integrated navigation systems algorithms and software. FY 1987 Program: Development of the technology base for low cost inertial sensors, integrated CNI antenna apertures, and integrated navigation techniques to satisfy future strategic/tactical aircraft and cruise missile requirements will be continued. An effort will be initiated to identify technology developments to satisfy a broad range of future hypervelocity vehicle avionics system needs. An effort will be initiated to develop a multifunction integrated inertial reference system design for Air Force and Navy tactical aircraft of the 1990s. FY 1988 Planned Program: Efforts will continue to develop low cost laser gyro technology. An Adaptive Tactical Navigation System and computation techniques and software structure for a low cost and

mission effective integrated navigation system will be developed and baseline demonstrations accomplished. An integrated communications identification navigation antenna aperture for Electronic Counter-Countermeasures will be completed. Payoff is reduction in system size, weight, power, and improved reliability and maintainability. Design concepts for autonomous navigation capability will be investigated and defined. FY 1989 Planned Program: Development will continue on advanced laser gyro concepts using fiber optics, multi-oscillators, and other technologies with emphasis on low cost, high reliability and improved performance. Specifications for multifunction integrated inertial sensor assembly systems of the 1990s for Air Force and Navy aircraft will be developed and confirmed through computer simulation and hot bench testing. System software for the Adaptive Tactical Navigation system will be thoroughly evaluated and specifications will be validated through a high fidelity laboratory demonstration model. A Kalman filter/software structure for strapdown inertial navigation systems which can perform special fault detection/isolation and reconfiguration functions will be validated and laboratory demonstrated. System level specifications for autonomous sensor/sensor systems which support endoatmospheric applications will be developed and confirmed through computer simulation. Hypervelocity technology base development for a broad range of hypervelocity reference system applications will be initiated.

G. (U) Project: 6096, Microelectronics Technology. This project develops selected solid state device and circuit technologies to achieve advances in information and signal processing capacity, reliability, and radiation hardness. Technical areas of consideration include integrated circuit devices and processing, high speed memory, signal processing circuit design, and interconnect technologies. This project is structured to complement developments in industry and other Government Laboratories. FY 1986 Accomplishments: Several new gallium arsenide devices and processes were demonstrated that enhance speed, power and circuit performance and the fabrication of these is being transitioned to pre-production pilot lines. An improved 64-pin package was demonstrated and transitioned to commercial production. An improved analog to digital converter was developed and transitioned to industry developing high resolution radar imaging systems. Significant progress has been made in Computer Aided Design technology that will reduce the nonrecurring design cost by a factor of ten. FY 1987 Program: Gallium arsenide and silicon device technology, especially in the areas of speed and complexity, will receive continued emphasis to meet ever increasing avionic processor requirements. These devices will improve reliability by reducing the number of integrated circuits to accomplish a function. Specific gallium arsenide analog to digital converter memory and multiplexers will be demonstrated for the Electronic Warfare digital radio frequency memory requirements. These devices and improvements are needed to meet future electronic warfare requirements. FY 1988 Planned Program: High performance device technology emphasis will continue. The gallium arsenide superlattice device technology will permit simultaneous improvements in speed, power, temperature and radiation hardness making it the military integrated circuit technology of the future. Three dimensional silicon devices will be demonstrated to improve the functionality of individual integrated circuits. A computer aided design tool for Very High Speed Integrated Circuits and gallium arsenide printed circuit board design will be demonstrated for electronic processing requirements of the 1990s. FY 1989 Planned Program: High performance devices technology emphasis will continue. Demonstration of complex gallium arsenide superlattice integrated circuits will occur. A gallium arsenide quantizer circuit will be demonstrated for Electronic Warfare requirements. All of these efforts support the need for improved performance and high reliability.

H. (U) Project: 7622, All-Weather Reconnaissance/Strike Avionics. This project develops the radar technology to support reconnaissance and strike operations using both airborne and spaceborne platforms. Radar is the only sensor that can acquire non-emitting targets at night, in all-weather conditions and, therefore, is widely used in both tactical and strategic applications. This project extends the inherent advantages of radar by establishing a firm technology base that supports: automated acquisition of small tactical targets; sensor concepts compatible with low cross-section airframes; radar operations in severe threat environments; and radar techniques effective against adversary low cross-section platforms. FY 1986 Accomplishments: Advanced low probability of intercept/electronic counter-countermeasures compatible waveforms were evaluated to determine which should be developed further to meet future electronic warfare threats. An automatic means was developed for extracting significant variations in the phase history of the Synthetic Aperture Radar (SAR) image, improving the present technique of "phase imaging." The net results are more accurate location and definition of primary target features effecting a much improved target identification/classification capability. The objectives of a joint Air Force/Navy program for developing bistatic SAR targeting technology were established. An assessment of the performance of current airborne interceptor radar against adversary low observable targets was conducted to determine areas where improvements are needed. Performance limits of contemporary X-band radar were established with radically new radar system design concepts suggested. FY 1987 Program: Continued analytical studies in advanced SAR targeting will result in specific near term implementation/configuration recommendations for the dual role fighter and the bistatic targeting demonstration testbed. The advanced radar target recognition work initiated in late FY 1986 will continue with expanded corollary activities. Counter low observables activities will continue with two novel different approaches being investigated. FY 1988 Program: The feasibility of promising air-to-air radar non-cooperative identification techniques not previously investigated (i.e., three-dimensional imaging, polarization, etc.) will be determined. Measurement and evaluation of multi-band polarization diversity techniques for enhanced surface target classification will be initiated. In-house and contract activities using artificial intelligence techniques for improved, in-weather surface target identification will continue. A program to identify militarily useful experiments using Shuttle Imaging Radar assets will be initiated. Candidates include refined bistatic synthetic aperture radar imaging experiments and low cross-section airborne target detection experiments. FY 1989 Program: Preliminary Design Reviews of two most promising approaches for an advanced Airborne Interceptor radar providing a detection, acquisition and fire control capability against low radar cross section targets will be completed. Based on prior analysis in advanced Raid Assessment, a follow-on phase to further develop and demonstrate the feasibility of the most promising approach will be initiated.

I. (U) Project: 7629, Fire Control Avionics. This project develops the methodology, software, and hardware implementation of fire control technology for increased accuracy in the delivery of weapons on targets. Specific goals are to develop requirements for the detection of targets and calculation of target locations; develop concepts which utilize advanced sensors, computers and data processing techniques to increase aircraft weapon delivery effectiveness and survivability; and demonstrate feasibility of these concepts by computer modeling and simulation. FY 1986 Accomplishments: Initial work has been accomplished to investigate avionics requirements for a new class of vehicle, the Strategic Boost Glide Vehicle, including the navigation and guidance functions. Analysis of manned air-to-air combat simulation data was accomplished to promote more thorough understanding of requirements and performance. Air-to-ground multiple target attack fire control preliminary designs were completed and transitioned to 6.3A for implementation and demonstration. Previous preliminary design of self-protection fire control has been improved and

moved a step closer to real-time, man-in-the-loop evaluation. Significant capital improvements to in-house simulation facilities were made in order to support future programs. FY 1987 Program: Continue efforts in order to meet future new avionics requirements for the Strategic Boost Glide Vehicle. A new program for preliminary design of real-time targeting system for strategic applications will be initiated. An in-house program to investigate sensor and data processing techniques to take advantage of multi-spectral sensor outputs will be initiated. Investigation of advanced fire control sensor configurations to include integration of radar and infrared sensors will be continued. These efforts should result in improved system capability and reduction in physical size of supporting systems. An in-house program to study feasibility of automated fire control for specific application will be initiated. FY 1988 Planned Program: A preliminary design will be initiated on internetted fire control which will perform integrated air-to-air and air-to-ground fire control and introduce the intra-flight internetting of shared data. A follow-on effort will be initiated in the area of program integration of advanced fire control sensors. An investigation of air-to-air attack algorithms for advanced fighter aircraft will be initiated. Efforts in real-time targeting, multi-spectral processing, and automated fire control will continue. All of these efforts are aimed at improving increased accuracy in the delivery of weapons on target. FY 1989 Planned Program: An in-house program to develop techniques for evaluation of automated fire control systems will be initiated to support independent evaluation of contractor prepared software. System definition of an automated fire control will be initiated. These efforts will improve the capability of tactical aircraft to deliver weapons on multiple targets, increasing effectiveness and survivability.

J. Project: 7633, Passive Electronic Countermeasures. The objective of this project is

FY 1986 Accomplishments: Capability to detect laser signals at over-the-horizon distances using aerosol scatter or cloud bounce was demonstrated. An infrared mosaic array and multi-colored detector to test and evaluate advanced discrimination techniques to eliminate false alarms in missile warning systems was delivered. Results of these efforts will help improve survivability of aircraft in the dense Electronic Warfare (EW) environment. An advanced EW signal preprocessor was added to improve in-house test capability. An improved "compact range" was installed to permit radar signature measurements on low cross section bodies at physically short ranges. FY 1987 Program: Fabrication of an advanced multi-spectral infrared warning receiver will be initiated as a follow-on to the previous work on reducing false alarms.

An effort to demonstrate the first instantaneous frequency measurement receiver with simultaneous signal handling capability will be started as a follow-on to theoretical design work from previous studies. FY 1988 Planned Program: Improvements will be made to the compact range to permit radar cross section measurements capability in the range of 35, 60 and 95 Gigahertz.

This effort will help improve survivability of aircraft in a hostile environment. An in-house evaluation of an advanced radar warning receiver concept using an acoustic-optical (Bragg Cell) architecture will be initiated. FY 1989 Planned Program:

A breadboard demonstration of an instantaneous frequency measurement receiver with simultaneous signal handling capability will be delivered. An all digital radar warning receiver will be initiated based on in-house design studies that are currently underway.

K. (U) Project: 7662, Avionics Data Transmission and Reception. This project addresses the growing need for a capability to transmit information to, from, and between aircraft with high integrity, low probability of hostile interception, and resistance to jamming and false transmission, along with small size and high reliability. Such links are vital for operationa control, weapon guidance, and reconnaissance data transmission. This work is vital to provide battlefield commanders with needed intelligence in near-real-time and to provide aircraft the ability to communicate in the presence of sophisticated enemy jamming. FY 1986 Accomplishments: The in-house laser laboratory supported the successful completion of the Laser Communication flight tests (HAVE LACE). Improvements to the in-house Communications System Evaluation Laboratory were made to meet future needs. New contracts were awarded for development of the technology for high speed optical computers for adaptive nulling, adaptive signal masking techniques, and Laser Communications Airborne Testbed development. The first, custom, Large Scale Integrated (LSI) circuits produced for a programmable filter were delivered. FY 1987 Program: Development will continue of custom LSI circuits for programmable filters for avionics applications. Development will continue of adaptive signal masking for communication, radar and electronic warfare transmissions by applying artificial intelligence techniques into adaptive algorithms. These efforts will improve the physical survivability of airborne platforms by providing high probability of covert, uninterrupted communications in a hostile, dense environment. Critical design reviews will be held for the optical computer and laser communications testbed programs. FY 1988 Planned Program: Continue all FY 1987 programs and initiate a new effort to mask communication signals within radar transmissions, a method that will improve the physical survivability of airborne platforms by allowing covert, uninterrupted communications in a dense, hostile environment. Methods will be addressed to allow for multiple, simultaneous message receive capability. The Laser Communications Airborne Testbed (LCAT) installation will be completed and flight tests will be started. FY 1989 Planned Program: The LCAT flight tests, which will be used to evaluate laser technology related to secure, low probability of intercept, jam resistant air-to-air and air-to-satellite communications, will be completed. A new contract will be awarded to develop solid state laser beam steering technology capable of rapidly scanning over wide angles in a high "G" environment. Demonstration of adaptive signal masking concepts in a laboratory environment will be completed. Another set of custom large scale integrated circuits will be delivered. A high speed optical processor/computer brassboard will be fabricated. A Communications System Evaluation Laboratory (CSEL) threat simulator will be developed. The facility will have capability for test and support of the Integrated Communication, Navigation, Identification Avionics and will provide a software system for fully automated CSEL hardware control. The necessary interfaces between CSEL and the Integrated Electromagnetic System Simulator will also be developed.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 06AA, Air Force Avionics Laboratory Operations

A. (U) Project Description: This project provides for the management and support of the Avionics Laboratory, Wright-Patterson Air Force Base, OH. It provides for the pay and related cost of civilian scientists, engineers, and support personnel; transportation of equipment; rental equipment; communications and utilities cost; procurement of supplies and equipment; duplication and reproduction services; and contractor support services for maintenance and modification of facilities. It also funds salary, travel and equipment cost for personnel at Aeronautical Systems Division who provide procurement support to the Avionics Laboratory. This project supports and complements all other projects in this program element.

B. (U) Program Accomplishments and Future Efforts: Not Applicable.

C. (U) Major Milestones: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62205F   Title: Personnel, Training, and Simulation
DOD Mission Area: 522 - Environmental and Life Sciences (ED)   Budget Activity: 1 - Technology Base

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986* Actual	FY 1987* Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		31,202	32,475	35,937	36,810	Continuing	N/A
06HT	Laboratory Support	11,027	10,717	11,058	11,246	Continuing	N/A
1121	Technical Training Development	2,112	1,880	2,050	2,500	Continuing	N/A
1123	Flying Training Development	3,136	3,020	2,953	3,700	Continuing	N/A
1192	Advanced Simulation for Pilot Training	5,180	5,390	5,525	6,170	Continuing	N/A
1710	Logistics and Maintenance Technology	3,871	3,808	4,557	3,700	Continuing	N/A
3017	Command and Control Training	1,209	1,300	1,600	2,304	Continuing	N/A
6114	Flight Simulator Technology	1,183	1,750	2,970	2,352	Continuing	N/A
7719	Force Acquisition & Distribution System	2,860	3,550	3,893	3,300	Continuing	N/A
7734	Force Management System	624	1,060	1,331	1,538	Continuing	N/A

* This consolidated Program Element 62205F contains all projects formerly funded in Program Elements 62205F and 62703F. Consolidation was accomplished to meet Congressional direction to reduce the number of Program Elements. Prior years reflect FY 1988 Science and Technology restructure for comparability purposes only.

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Science and Technology program will improve operational readiness and effectiveness by developing technologies to enable more effective training, selection, assignment, and retention of personnel. This program also provides the technology to increase weapon system supportability. Major research efforts are on aircrew training using various flight simulation devices to develop innovative methods for flight simulator training, define simulator training effectiveness requirements, and develop innovative techniques for training tactics for air-to-ground and air-to-air combat. Other research involves improved individual and unit training methods, instructional and learning strategies, and training design and evaluation technologies. Specific technical programs include development and demonstration of: personnel testing procedures, methods to determine Air Force job requirements, processes for matching individuals to jobs, models and strategies to improve retention, the means to measure and evaluate job performance in order to link enlistment standards to on-the-job performance, models for integrating manpower personnel and training decisions, computer modeling to address fundamental training management issues, tools for computer-based training, maintenance training simulators, and artificial intelligence applications to training. Another major R&D area addresses the logistics support of weapon systems and improvements that can be made by specifying the interactions between the human elements of the logistics and maintenance systems, and the associated characteristics of weapon systems. This program also provides management and operational support for the AF Human Resources Laboratory, Brooks AFB, TX.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
RDT&E Program Element 62205F	25,435	26,802	28,196	N/A	Continuing	N/A
RDT&E Program Element 62703F	8,556	9,806	10,221	N/A	Continuing	N/A
Total RDT&E	33,991	36,608	38,417	N/A	Continuing	N/A

EXPLANATION: (U) The FY 1986 reduction was affected by Congress to meet budget ceiling goals. FY 1987 reduction is a reeult of Congressional budget action. FY 1988 reduction is to accommodate reduced Total Obligation Authority.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: Related program elements are: 61102F, Defense Research Sciences; 62202F, Aerospace Biotechnology; 62204F, Aerospace Avionics; 62702F, Command, Control, and Communication; 62763N, Personnel and Training Technology; 63707N, Manpower Control System Development; 62717A, Human Performance Effectiveness and Simulation; 63106F, Logistics Systems Technology; 63227F, Manpower, Personnel, Training, and Simulation Technology; 63231F, Crew Systems Technology; 64227F, Flight Simulator Development; 62757N, Human Factors and Simulation Technology; 63733N, Training Devices Technology; 63720N, Education and Training; 62722A, Manpower, Personnel, and Training; 62727A, Non-System Training Devicee Technology; and 63216A, Synthetic Flight Simulators. The Air Force Human Resources Laboratory has formal agreemente with: the Army Program Manager for Training Devices, for visual display and advanced computer image generation technology development; Tactical Air Command for flying training R&D and to help develop flight training schedules using Advanced Instructional System software; Aeronautical Systems Division, to coordinate simulator research and development with the Deputy for Simulators; Air Force Wright Aeronautical Laboratories, for development of computer-aided design technology; the Army and Navy, to share development of a computerized instruction system; and with the Air Force Armstrong Aerospace Medical Research Laboratory and Rome Air Development Center, to share research products related to command and control systems. The Navy has a liaison office with the Human Resources Laboratory's Operetions Training Division at Williams Air Force Base, AZ. Air Force efforts to improve the Armed Services Vocational Aptitude Battery and the production of new forms of that test are directed, in part, by a tri-Service steering committee of General Officere. In addition, DOD Technical Advisory Groups provide coordination between specific focal points for reseerch and development efforts. Close coordination within the Air Force user community is also ensured by annual research end development coordination meetings between the Air Force Human Resources Laboratory, the Aeronautical Systems Division at Wright-Patterson Air Force Base, OH, and the major commands (Tactical Air Command, Strategic Air Command, Militery Airlift Command, Air Training Command). Efforts across all Services to develop job performance measures are coordinated by a working group monitored by the Office of the Assistant Secretary of Defense for Force Management and Personnel.

Program Element: 62205F Title: Personnel, Training, and Simulation
DOD Mission Area: 522 - Environmental and Life Sciences (ED) Budget Activity: 1 - Technology Base

6. (U) WORK PERFORMED BY: This program is managed by the Air Force Human Resources Laboratory (AFHRL), Brooks AFB, TX. Four Laboratory divisions support this program element: Manpower and Personnel Division, Brooks AFB, TX; Logistics and Human Factors Division, Wright-Patterson AFB, OH; Operations Training Division, Williams AFB, AZ; and Training Systems Division, Brooks AFB, TX. An Operating Location of the Training Systems Division is collocated with the Air Training Command Technical Training Center at Lowry AFB, CO. The major contractors are: University of Dayton, Dayton, OH (1123, 1192, 6114); General Electric, Daytona Beach, FL (1192, 6114); Singer Company, Binghamton, NY (1123, 1192, 6114); McDonnell Douglas, St Louis, MO (1123, 7734) and Aurora; CO (1121), and Universal Energy Systems, Dayton, OH (1121, 3017, 7719). There are 74 additional contractors with contracts totalling $9.6 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 1121, Technical Training Development. Efforts to improve training delivery, development and effectiveness must be maintained to stay abreast of Air Force training requirements and insure that training produced is cost-effective and mission-relevant. This project develops training technology to enhance individual and unit training. The result will be improved individual skills development and job performance. Efforts include: using computers to investigate and measure job performance; developing computer-based training (CBT) delivery, management, and evaluation systems; and investigating and demonstrating artificial intelligence (AI) applications for training. In FY 1985, the Instructional Support System (ISS) was released as a prototype, government-owned CBT system. It is written in Ada, in a modular format and is transportable to a variety of computer systems. In FY 1986, a portable computerized expert system for maintenance technicians was demonstrated. This system integrates training and job-aiding to provide training simulation for fault isolation, troubleshooting techniques, information on how to perform maintenance tests, and the capability to diagnose shortcuts in troubleshooting. Operational Test and Evaluation (OT&E) of ISS began, with its use in B-1B aircrew training. Also in FY 1986, interface specifications were developed to enable the use of video disc technology with ISS for training delivery. ISS currently supports multiple users, among them the Air Force Academy, Air Force Institute of Technology, and the National Aeronautics and Space Administration. Additional ISS implementations and upgrades taking place in FY 1987 include integration into the Air Force Advanced On-the-Job Training System, and Air Training Command's Advanced Training System. A joint effort with the Army Research Institute and the Naval Training Systems Center is building intelligent authoring aids for training development and designing and developing knowledge-bases for multiple AI applications. The Tri-Service contract for intelligent systems will complete development of a prototype student knowledge base system in FY 1987. Development of an intelligent tutoring system based on a previously developed intelligent maintenance aid will continue. Also in FY 1987, intelligent coaching systems for the Ada and Prolog computer programming languages are being developed; as is a microcomputer implementation and networking system for the ISS. Also, work began on computerized job performance measurement and a generic embedded intelligent tutor which will be available at the job site via workplace computerized equipment. In FY 1988, research will be conducted to create effective computer-based training (CBT) development and evaluation tools to make CBT a more effective delivery media and decrease the costly front-end CBT investment for trainers. Also in FY 1988, a demonstration of on-line, computer-based job performance tests for an Air Force specialty will be completed; development efforts will continue on the intelligent tutorial system, and efforts to use natural language (speech) processing to enhance the human-computer interface will continue. Efforts to determine the feasibility and effectiveness of using intelligent tutorial systems to increase learning and job competency will also begin. In FY 1989, the Tri-Service

effort will complete development of software tools for use by courseware authors in developing intelligent training systems, with specific demonstrations to take place in space operations training at the Undergraduate Space Training School. These tools will be designed for use by subject matter experts without the need for extensive training or background in instructional design or computer programming. In FY 1989, the computerized job performance measurement system developed in FY 1988 will be field tested and its potential for further development in Air Force specialties evaluated. Also in FY 1989, an intelligent instructional design will be developed for space environment.

B. (U) Project: 1123, Flying Training Development. There is a continuing Air Force need to reduce the cost of all types of aircrew training while maintaining or improving the quality and the effectiveness of training. This project applies new methods, techniques, and devices to flying training and aircrew performance assessment to increase proficiency during flying training and in combat aircraft. In FY 1986, research efforts increased on simulator fidelity required for effective training using the advanced image generation and display hardware developed in PE 63227F, Personnel, Training, and Simulation. Also in FY 1986, advanced radar and other sensor simulation system displays were tested for aircrew training; a simulator instructor/operator station (IOS) design guide was developed which will be used to develop multi-cockpit IOS design guides and modular IOS software; special-function part-task trainers for electronic combat were evaluated for integration into a Tactical Air Command (TAC) training program; and a behavioral performance measurement system design for use with the F-15 was completed. A number of efforts began in FY 1987, including: development of specifications for the design of Total Training Systems to provide the most cost-effective training for a weapon system; an effort to investigate the degree to which simulator training, in simulated combat conditions, increases performance in high workload conditions in aircraft; and development of an artificial intelligence model of pilot knowledge structures for use in training and evaluating combat decision-making strategies. Work will also continue in FY 1987 and FY 1988 on preparation of a handbook to assist in the design of better, more cost effective, and training effective special function trainers. Investigations to be completed in FY 1988 are the criteria for simulator display resolution and the level of detail required for air-to-air and air-to-ground simulated tactical targets. Planned FY 1988 new starts include: research on critical visual cues for low level flight to improve visual modeling of low-altitude environments in flight simulators and part-task trainers; and development of a modular threat simulation system to support the development and evaluation of an integrated full mission electronic combat training program. Another new FY 1988 effort in the part-task training area will develop artificial intelligence software to allow aircrew training operators to efficiently design and interact with part-task trainers. Recommendations for use of color in flight simulators will be made early in FY 1989, based upon comparisons of low-altitude flight task performance accomplished using color and monochrome imagery. Studies, to identify visual scene fidelity requirements definition for Air Force simulator acquisitions, will continue in FY 1989. The development of integrated electronic combat training media guidelines will also continue in FY 1989, as will development of a training program to optimize pilot workloading during low-altitude flight, and studies of aircrew performance measurement systems. One study will develop and validate plans for a stand alone performance measurement system capable of acquiring data from the Simulator for Air-to-Air Combat as well as Air Combat Maneuvering Instrumentation ranges. A second study will identify and quantify relevant pilot behaviors required to detect threats and to accomplish mission objectives in surface attack maneuvers.

C. (U) Project: 1192, Advanced Simulation for Pilot Training. This project provides for the operation, maintenance, and modification of simulation equipment and software that is the foundation for research on training

effectiveness and flight simulator engineering R&D. This capability includes dome, dodecahedron, and helmet-mounted visual displays; computer image generation systems; and related research equipment. These simulation systems support all research conducted under Project 1123, Flying Training Development, and Project 6114, Flight Simulator Technology, as well as research conducted under PE 63227F, Personnel, Training, and Simulation, and thus provide the capability for implementing, demonstrating, and testing training technology and simulation hardware advancements. This capability is also used for demonstrating and testing engineering and training simulation technology advances developed under related Aeronautical Systems Division and Tri-Service program elements listed under related activities. In FY 1986, the F-16A simulator was updated and software configuration and conversion of R&D simulation software to the new DOD standard programming language, Ada, was begun. Delivery and installation/integration of a new basic-side (non-visual) control computer with much higher processing rates, capable of matching the characteristics of current state-of-the-art tactical aircraft was also begun. This will permit dual cockpit simulation with full sensor capability, coupled with the out-the-window visual imagery. In FY 1987, development of a functionally distributed parallel microprocessing capability began. Enhancements are being made to the existing F-16A and A-10 instructor/operator stations to allow improved instructor/operator and student/pilot interaction. Hardware integration and software development for the new basic side (non-visual) control computer is being completed in FY 1987. Support will continue in FY 1988 and FY 1989 for the operation and maintenance of all major simulator systems, including the Advanced Visual Technology System image generator (Project 2363, PE 63227F). Simulation support for related research projects will also continue, including training effectiveness and transfer of training studies, visual and sensor systems requirements studies, and tactical combat mission simulation studies.

D. (U) Project: 1710, Logistics and Maintenance Technology. Acquisition of weapon systems that are logistically supportable, sustainable, and cost effective is being emphasized by all levels of the Air Force and DOD. Military systems must be durable, easily maintained/repaired in the field, and require little or no support equipment. The objective of this project is to develop technologies for improving the logistics support of Air Force combat operations. In FY 1986, a study was conducted on maintenance and logistics factors that impact combat capability, providing data for a computerized model to generate wartime demand rates for aircraft electronic countermeasures equipment under combat conditions, as well as recommendations to improve weapons systems equipment design. A methodology was developed to measure the capability of a peacetime unit to successfully perform maintenance or logistics support in a wartime environment. In FY 1987, work will continue on the identification of tradeoffs in personnel, job aids, and support equipment to minimize the manpower and equipment necessary to conduct aircraft maintenance in dispersed locations. Additionally, development will continue on a task assignment methodology for identifying/selecting combat maintenance personnel and evaluating options available to fulfill the task performance requirements. The analysis and testing to determine the ability of personnel to complete maintenance tasks while wearing chemical/biological warfare protective clothing will be completed in FY 1987. Also in FY 1987, a new effort will begin to develop a computer "super" model to assess theater-wide combat logistics system resources and requirements, using an operations model as a core. Planning, logistics assessment, and susceptibility models will be used as modules to provide more realistic computation of wartime logistics capabilities. In FY 1987, a computer graphics model of maintenance technician physical characteristics (reach, grip, hand motions, etc.), for use in designing human factors into equipment, will be refined and interfaced with a commercial computer-aided design package for transition to Government and industry users. In FY 1988, efforts will continue on the theater-wide logistics resources and

requirements assessment model. An FY 1988 new start will evaluate the use of advanced graphic techniques to integrate reliability and maintainability information into computer-aided design. In FY 1989, work will continue on the theater-wide logistics model and the development of decision aids for the acquisition logistics process. Also in FY 1989, a model for forecasting wartime logistics requirements will be completed and historical combat data will be collected to validate the model.

E. (U) Project: 3017, Command and Control Training. Combat readiness of personnel assigned to man tactical Command and Control (C^2) systems is directly related to their ability to operate smoothly and efficiently in a rapidly changing tactical environment. The failure of C^2 systems is often due to inadequate attention being placed on personnel training requirements and other human factors considerations during the design and development phases of new systems. There is a recognized need for improvements in C^2 training for Tactical Air Force battle staff personnel. This project develops technology and applications programs to analyze wartime job requirements and performance standards, determines training requirements, identifies and models the impacts of automation on operators, analyzes combat decision making, and develops new technology for training devices. In FY 1986, work to improve combat readiness of tactical C^2 personnel continued in the areas of team training assessment, decision aiding, and operator/system interaction. A Logistics Readiness Center Training module was completed in FY 1986. Efforts ongoing in FY 1987 include: development of a prototype special simulation device for training combat mission planners, development and testing of an automated method for ongoing dynamic update of a worldwide command and control training requirements baseline, and exploration of computer-aided concepts to provide more precise threat avoidance information for mission planning. Also, work will begin on methods to simulate the impact of automating previously manual command and control functions. In FY 1988, knowledge based training system concepts will be developed for combat operations functions. Exploratory work will begin on a microcomputer-based desktop trainer for ground-based operators of space-based systems. Work will also begin on the information/decision analysis for a functionally distributed tactical command and control architecture in development at the Rome Air Development Center. In FY 1989, the prototype knowledge-based training system for tactical combat operations will be tested. The architectural concepts of functionally distributed command and control will be tested at multiple locations. Simulation methods for evaluating the impact of automation on manual command and control processes will be demonstrated in FY 1989.

F. (U) Project: 6114, Flight Simulator Technology. The Air Force must improve the quality and cost effectiveness of aircrew training. This project develops efficient and effective simulation hardware technology for future aircrew training systems. These technologies will provide sufficient mission realism for aircrew training and weapon system exercise and assessment. In FY 1986, an off-line software program was developed which automates the creation of infrared computer-generated imagery on the Advanced Visual Technology System (AVTS) (Project 2363, PE 63227F). A follow-on effort, in FY 1987, is upgrading AVTS infrared image capability through feature texturing. In FY 1986, an effort began to explore the feasibility of using a low-cost image generation architecture for producing a simulated real-beam radar scene from a Defense Mapping Agency compressed data base. This effort will continue in FY 1987 as will work on component technology in support of low cost networked simulators. In FY 1988, a small dome visual display system will be completed, exploiting an opportunity to apply variable-acuity display technology to Fighter Lead-In Training for Tactical Air Command (TAC). In addition to meeting a TAC need for simulation in this area, it will also provide training effectiveness data for other simulation applications. Emphasis will be on visual systems comprised of

electro-optical displays and microprocessor-based computer image generators. This work will continue through FY 1989. A second generation variable acuity visual system effort will be developed in FY 1990 and incorporated into the F-15 simulator network in FY 1991.

G. (U) Project: 7719, Force Acquisition and Distribution System. This project provides the Air Force with methods to ensure the best qualified individuals are recruited, selected, classified, and assigned. This is accomplished through research and development of personnel qualification and aptitude tests, job specification standards and manpower and personnel models. Experimental test batteries will be developed in areas such as attention sharing, eye-hand coordination, information overload, self-confidence and others. As the Department of Defense Executive Agent for the Armed Services Vocational Aptitude Battery (ASVAB), the Air Force must provide the technology base for revising and updating the content and structure of this test which is used by all Services for selection and classification. In FY 1986, major effort was begun to measure the basic skills requirements of Air Force jobs and functional skills of individuals. This data will be used to develop intelligent tutoring systems to train individuals deficient in critical job skills. Also in FY 1986, revalidation of the Weighted Airman Promotion System was completed. Research to improve selection of pilot trainees and the subsequent assignment of pilots to specialized training will continue in FY 1987. Preliminary data indicate this research will lead to reduced pilot training attrition to achieve significant savings. In FY 1987, a major new effort will continue to consolidate ongoing job requirements and modeling research and initiate new projects to develop a manpower personnel and training integration system (MPTIS). The MPTIS will provide tools, such as models and data bases to support system design, developing personnel and training pipeline and retraining requirements for fielding new weapon systems, and integrating the MPTIS decision process into existing systems. Also, in FY 1987, exploratory development will continue on the Air Force Officer Qualifying Test and the ASVAB. Also, three new editions of the ASVAB will be implemented during FY 1988 and work will continue to improve selection and classification methods through basic skills assessment research, MPTIS related efforts, and testing research and validation. Also in FY 1988, task demands in air combat will be determined, characteristics of successful fighter pilots will be identified, and specialized tests for classification of fighter-attack-reconnaissance pilots will be validated. In FY 1988 a study will be completed to develop a methodology for determining the value or cost of replacement of trained and experienced personnel. This study is in direct response to the FY 1984 Authorization Bill language which directs the Department of Defense to fund the development of models and procedures to enhance retention of personnel. The primary benefit of this costing methodology will be the establishment of the relative value of Air Force personnel with different levels and types of skills, enabling Air Force managers and planners to respond in a more informed manner to dwindling manpower pools, decreased retention, budgetary constraints, and policy decisions. In FY 1989, projects will continue to provide new, alternate, or replacement forms of tests to be used in the Air Force as well as other Services and DOD sponsored high school student testing programs. Efforts will continue to develop valid measures of fighter aircrew performance and in-depth analyses of task/information processing demands. Research into the determination of valid entry level standards for specialties will provide information and technology in the basic skills requirements of Air Force jobs and functional skills. Also in FY 1989, a final evaluation of the EURO-NATO Joint Jet Pilot Training Program will be completed.

H. (U) Project: 7734, Force Management System. The Air Force needs to develop methodologies for assessing individual performance on the job and predict effective job performance. Improved measurement techniques will enhance

individual performance and unit effectiveness at all organizational levels. These techniques will also be used to develop a training decision system (TDS) for answering questions such as when and where personnel should be trained, and on what tasks. The TDS includes a more comprehensive and better unified data base and better decision modeling technologies than ever available for estimating the training cost, resources, and capacities associated with optional patterns of training and personnel utilization. The development of task-level job performance measurement techniques will continue, as will the development of on-the-job performance measures against which selection devices, such as the Armed Services Vocational Aptitude Battery, are to be validated. The Congressional direction to link enlistment standards to on-the-job performance measures has resulted in close monitoring of this effort by the Office of the Assistant Secretary of Defense for Force Management and Personnel (OASD/FM&P). In FY 1986, a prototype job performance measurement system for jet engine mechanics was completed, as was a conceptual study on the use of job performance as criteria for evaluating training effectiveness and a plan for institutionalizing job performance measurement technology was submitted to OASD/FM&P. Studies were completed on how mental aptitudes affect job performance, especially the time it takes to achieve proficiency, and the effects of rater training on performance assessment ratings. In FY 1987, job performance measurement efforts are continuing to study global/general supervisory ratings and task-level ratings as effective job performance measures. In FY 1987, TDS will integrate data from task analysis, training cost studies, and policy development models. In FY 1988 TDS will simulate and project consequences of user specified utilization and training options and develop optional training designs. In FY 1989, the application of enlisted measurement procedures for assessing officer and civilian jobs will be explored. Work will continue in support of the development of job performance measures through FY 1990.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 06HT, Laboratory Support.

A. (U) Project Description. This project provides for the operation of the Air Force Human Resources Laboratory (AFHRL), Brooks AFB, TX, including pay and related costs of civilian scientists and support personnel, travel, transportation, rent, communications, maintenance, procurement of supplies and equipment, and contractor support services. It also funds civilian salaries, travel, and supplies for personnel at the Aeronautical Systems Division (ASD), Wright-Patterson AFB, OH, who provide procurement support to AFHRL. The laboratory performs research and development in manpower and force management, weapon systems logistics, maintenance and technical training, and air combat tactics and flying training in support of immediate or potential needs of Air Force operational systems. This project supports and complements all projects in this program element.

B. (U) Program Accomplishments and Future Efforts: Not Applicable.

C. (U) Major Milestones: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62206F — Title: Civil Engineering and Environmental Quality
DOD Mission Area: 522 - Environmental and Life Sciences (ED) — Budget Activity: 1 - Technology Base

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT	6,639	6,757	5,678	6,046	Continuing	N/A
1900 Environmental Quality Technology	4,103	3,719	2,439	2,604	Continuing	N/A
2673 Civil Engineering Technology	2,536	3,038	3,239	3,442	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Science and Technology program develops technology for civil engineering and Air Force-unique environmental requirements in deploying, operating, and maintaining Air Force weapon systems. This goal is achieved by exploratory development in the areas of: air base facility and utility (e.g., power lines) survivability against conventional weapon threats; post-attack facility & utility repair; aircraft crash rescue and fire suppression; construction and maintenance of airfield pavements; and control, detection, and disposal of pollutants and wastes generated during Air Force operations such as rocket launches, jet engine tests, inadvertent fuel spills, aircraft maintenance, and waste reduction and remedial actions for Air Force site clean-up activities.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	9,225	5,425	5,916	N/A	Continuing	N/A

EXPLANATION: (U) The changes in FY 1986 and FY 1987 resulted from transfers to and from the Defense Environmental Restoration Program central transfer account.

4. (U) OTHER APPROPRIATION FUNDS: Not applicable.

5. (U) RELATED ACTIVITIES: The efforts within this program are of significant interest to the other services and are coordinated through the Joint Services Civil Engineering Research and Development Coordinating Group, which guards against duplicating efforts and works to maximize technology transfer. All Air Force efforts in environmental quality R&D are reviewed annually by the Office of the Under Secretary of Defense for Research and Engineering to preclude duplication within the military services and between the services and other agencies. The Air Force (HQ Air Force Engineering and Services Center) and the Navy (Naval Air Systems Command) have a memorandum of agreement to conduct joint programs for aircraft fire suppression and crash rescue. This program funds efforts that transition for advanced development into PE 63723F, Civil and Environmental Engineering Technology. Additionally, PE 61102F, Defense Research Sciences, funds efforts which feed the technical areas in this PE. PE 62601F, Advanced Weapons, Project 8809, Nuclear Vulnerability and Hardening Technology, funds related civil engineering efforts. Frequent technical exchanges between the Air Force Weapons Laboratory and the Engineering and Services Laboratory preclude duplication. Other related

programs are included in PE 62203F, Aerospace Propulsion, and PE 62202F, Aerospace Biotechnology.

6. (U) WORK PERFORMED BY: In-house and contractual efforts are conducted by the Air Force Engineering and Services Laboratory, Tyndall Air Force Base, FL. Other government resources are used, including those of the Departments of the Army, Navy, and Energy, the Environmental Protection Agency, and the National Aeronautics and Space Administration. The top five contractors and associated projects are New Mexico Engineering Research Institute, Albuquerque, NM (2673); University of California, Irvine, CA (1900); University of Florida, Gainesville, FL (1900); AMETEX, Inc., Santa Barbara, CA (2673) and Battelle Columbus Laboratories, Columbus, OH (1900). There are 25 other contractors with a total dollar value of $2.7 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 1900, Environmental Quality Technology. This project characterizes the chemistry of Air Force-generated pollutants and toxic materials, assesses their interaction with the environment, and develops control and cleanup technologies. As environmental regulations become stricter, the technology and procedures used to ensure compliance become more expensive and complex. This project conducts research to reduce the cost and increase the effectiveness of technologies that protect the environment. New and future Air Force fuels and chemicals, such as jet engine and rocket fuels, are monitored in this project in order to anticipate and prevent environmental problems from occurring and to prevent delays in testing and fielding weapon systems. FY 1986 accomplishments. The following work was completed: testing with the U.S. Army of stable, effective water purification agents for mobility operations; laboratory studies of burning as a disposal technique for large spills of liquid missile fuels; and development of a model that aids in evaluating the environmental effects of new jet fuels. Laboratory studies were begun on innovative technologies to reduce the cost of decontaminating Air Force hazardous waste sites. Planned work for FY 1987. The following will be completed: determining the environmental interactions of hydrazine-based liquid rocket fuels; laboratory-scale development of a procedure that speeds the regulatory approval of using Air Force incinerators to safely dispose of hazardous wastes; determination of the characteristics that objectively indicate when to replace aircraft parts cleaning solvents, resulting in longer use of the solvents and reduced amounts of hazardous wastes; updating a hazardous gas dispersion model with information on toxic gases which are denser than air; and laboratory-scale evaluations of methods to destroy organic compounds that are removed from contaminated groundwater. The following will be initiated: studies on the movement of dioxin (the contaminant in herbicide orange) in soils to provide a scientific basis for scheduling site cleanup; laboratory-scale testing on methods to reduce the hazardous wastes generated from testing bullets containing depleted uranium; and investigations of the environmental interaction of metallic compounds (primarily from leaking underground gasoline storage tanks) to provide technical data for site cleanup planning. Planned work for FY 1988. The following will be completed: characterization of soot particles from Air Force jet engines, providing important environmental quality data; and studies of an instrument that accurately measures hydrochloric acid in the cloud formed during rocket launches (over 15 tons of the corrosive material is generated by a Titan III rocket). The following will be initiated: research into the photochemistry of chemicals released during jet engine operations, permitting the determination of the impact of aircraft operations on local air quality; studies on the environmental impact of new solid and liquid rocket propellants; and determination of the environmental effects of a new polyurethane for rapidly repairing bomb damaged runways (many airbases will store

several thousand gallons of the polyurethane). Planned work for FY 1989. The following will be completed: fundamental studies of how fuel additives can prevent soot formation in jet engine tests, thus reducing the testing's environmental impact; design specifications of a combustor that destroys contaminated liquid rocket fuels and complies with standards for nitrogen oxide, a chemical formed during the burning; and research on marker compounds that identify the source of fuel spills, proving or relieving Air Force responsibility for the cleanup. The following will be initiated: investigation into the environmental effects of an artificial ionospheric mirror (a new technology to detect aircraft and missiles using high-powered radiofrequency ground stations); characterization of new rocket fuels containing beryllium, which forms a hazardous product in soils and groundwater; and development of cost-effective techniques to reduce or control volatile organic compounds, which are chemicals generated during most Air Force industrial operations, such as painting aircraft.

B. (U) Project: 2673, Civil Engineering Technology. This project provides a technology base to identify problems and develop solutions for current and future Air Force systems in the areas of survivable structures and utilities, airfield pavements, and fire suppression. The facility and utility research exploits new materials and construction techniques to improve survivability against increasingly accurate and powerful conventional weapons. The airfield pavement research analyzes the wear and failure mechanisms of runways to develop improved materials for repairing and recycling activities. The fire research develops new fire suppression agents to respond to advanced fuels and materials used in Air Force weapon systems. FY 1986 accomplishments. The following were completed: laboratory testing of an advanced concrete made with steel fibers that increase its penetration resistance; investigations of a very high strength concrete for hardened and semihardened structures such as missile silos; tests of model structures in a centrifuge that evaluates the effects of gravity during an explosion; and the formulation of a new agent to extinguish fires of magnesium aircraft components (in 1985, two fighter and one large aircraft were destroyed because the magnesium fires could not be put out). Planned work for FY 1987. The following will be completed: a study of a material, added during pavement recycling, that increases the durability of asphalt; and research on small-scale modeling of layered pavements, centrifuge testing techniques, and centrifuge modeling of penetration phenomena. Scaled testing in the centrifuge provides data that dramatically reduce R&D costs. The following will be initiated: a feasibility study to determine applications for artificial intelligence in civil engineering systems such as pavement and facility design; investigation of various cement additives to reduce voids in concrete and thereby improve performance in blast and shock situations; evaluation of what happens to equipment in buildings close to detonating weapons; development of a model to predict rutting of asphalt pavement caused by high pressure aircraft tires (initial estimates indicate that a loaded F-15 C/D reduces the life of asphalt pavement by 50 percent); and a feasibility study for a remotely controlled robot to provide an increased fire suppression capability in ultra-high risk environments (e.g., munition-laden aircraft). Planned work for FY 1988. The following will be completed: investigation of high strength concrete properties resulting in a material that can be used in slabs placed next to a building that cause a weapon to detonate prior to impact on the building; development of cheaper and more reliable gages that measure shock wave acceleration near explosions during structures tests; and investigations of the response and failure of the layers of aggregate underneath runway pavements subjected to high aircraft landing gear loads. The following will be initiated: analysis of structural elements that fail from close-in explosions of conventional munitions, thereby reducing the design safety factor; evaluation of methods to assess post-attack damage to facilities; studies of the effects of moisture on pavement performance; and development of a fire

suppression agent for aircraft composite material fires (existing agents either can't extinguish the fire or react adversely with the materials). Planned work for FY 1989. The following will be completed: development of a microcomputer program to rapidly analyze the structural integrity of a damaged facility; studies of post-attack damage assessment of facilities; and development of a foam that can extinguish various types of fires using 50% less foam. The following will be initiated: development of advanced structural modeling technologies to reduce facility design costs; and development of a chemical that will mix with spilled fuel to impede burning.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not applicable.

9. (U) COOPERATIVE AGREEMENTS: Not applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62302F Title: Rocket Propulsion
DOD Mission Area: 523 - Engineering Technology (ED) Budget Activity: 1 - Technology Base

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		37,913	38,251	43,339	44,283	Continuing	N/A
06RL	Laboratory Operations	12,183	12,307	12,890	13,157	Continuing	N/A
2864	Interdisciplinary Space Technology	3,345	3,228	3,510	3,577	Continuing	N/A
3058	Space Propulsion Technology	8,285	9,260	9,787	10,012	Continuing	N/A
3059	Ballistic Missile Propulsion Technology	4,451	2,991	3,176	3,239	Continuing	N/A
3148	Air-Launched Missile Propulsion Technology	4,194	4,489	4,807	4,881	Continuing	N/A
5730	Multiple Applications Technology	5,455	5,976	9,169	9,417	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Science and Technology program exploits new concepts and techniques for developing rocket propulsion and interdisciplinary space technology. Work at this level is accomplished in laboratory or bench-scale tests to prove the feasibility of new technologies before larger scale demonstrations. The goal is providing increased mission capability, cost effective weapons, and more reliable, maintainable systems. Technology products from this program help to meet the need to launch greater payloads at lower cost and deliver more munitions at longer ranges. The program also provides for the management and support of the Rocket Propulsion Laboratory at Edwards Air Force Base, CA. The efforts in this program do not duplicate tasks conducted under the Strategic Defense Initiative.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	40,066	41,890	43,945	N/A	Continuing	N/A

EXPLANATION: (U) Differences are due to Gramm-Rudman-Hollings reductions in FY 1986 and Congressional reductions in FY 1987.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
Military Construction: Funds	2,330	5,500	0	17,800	Continuing	N/A

5. (U) RELATED ACTIVITIES: Technology base activities in this program are related to National Aeronautics and Space Administration (NASA), Navy and Army programs. Coordination is accomplished through the Joint Army-Navy-NASA-Air Force Interagency Propulsion Committee, and through working level meetings and inter-service committees. All reports and outputs are coordinated through a central data base under the Chemical Propulsion Information Agency. This Exploratory Development program provides the technology base for Advanced Technology Demonstration under PE 63302F, Space and Missile Rocket Propulsion.

6. (U) WORK PERFORMED BY: The Air Force Rocket Propulsion Laboratory, Edwards Air Force Base, CA, manages this effort. The in-house efforts are conducted at numerous active experimentation areas to evaluate sub- and full-scale rocket propulsion systems and components. The top five contractors in FY 1986 are Aerojet General, Sacramento, CA, (Projects 3058, 3059, and 5730); United Technologies, Chemical Systems Division, Sunnyvale CA, (Projects 3058, 3059, 3148, and 5730); Morton Thiokol, Brigham City, UT and Huntsville, AL, (Projects 3059, 3148, and 5730); Rockwell International Rocketdyne Division, Canoga Park, CA, (Projects 2864, 3058, 3059, and 5730); and Atlantic Research Corporation, Gainesville, VA, (Projects 3058, 3059, and 3148). There are 40 other firms with contracts totaling $7.5 Million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 2864, Interdisciplinary Space Technology. This project provides the integration of key propulsion and non-propulsion disciplines necessary to develop enabling technology for future Air Force space systems. Technologies are being developed in three sub-thrusts: spacecraft enabling technology, spacecraft operational logistics, and space-defense technology. In FY 1986 the project experimentally demonstrated the feasibility of a liquid droplet radiator for high-power systems with a projected 75 percent weight reduction from current radiators. Liquid droplet radiators will enable spacecraft with high power requirements to dissipate large amounts of waste heat with compact, lightweight radiators. This project also demonstrated an experimental technique to simulate operating conditions necessary to evaluate contamination effects on spacecraft surfaces. Planned for FY 1987 is a demonstration of a computer controlled method of maintaining delicate space-structure shapes during orbital operations. The buildup for a shuttle mid-deck experiment will also be completed that will provide fundamental information on liquid propellant behavior needed to design equipment for propellant transfer operations in a zero gravity environment. Goals for FY 1988 include demonstrating liquid droplet radiator and multi-layer insulation technology, and initiating work to characterize and control contamination from fuel-venting operations for on-orbit resupply of satellites. The liquid droplet radiator experiment will demonstrate a working-fluid collector in zero-gravity. The collector is required to recapture the working fluid after it has been sprayed from the droplet generator and the waste heat has been radiated to space. The insulation technology will verify the techniques required to produce a high number of layers of insulation that will enable long term passive or active storage systems for cryogenic propellants or coolants. The storage systems will extend the life of spacecraft that use cryogenic fluids. FY 1989 work will include transition liquid droplet radiator technology to a prototype demonstration, continuing the study of methods to control the deployment of fragile space structures such as large antennas, conducting measurements in space of contamination from fuel venting, and transitioning of multi-layer insulation technology to new tank concepts for advanced spacecraft.

B. (U) Project: 3059, Ballistic Missile Propulsion Technology. This project develops technology to provide flexible basing and increased range, and enhances survivability of future systems. These technologies could be used in a small, mobile ballistic missile to increase range or payload by 30 percent. This project has identified manufacturing variables which affect the operational life of ballistic missiles. Control of these variables will allow increased life of a missile in a flexible basing mode. New analytical techniques are under development that more accurately determine propellant properties to improve designs and reliability of future systems. This project has also identified new composite material combinations to reduce the motor case weight and tested three-dimensional carbon/carbon nozzle materials to increase reliability of the system. A dissection test vehicle was developed in FY 1986 to experimentally investigate the effects of manufacturing variables on the structural integrity of the propellant bond to the motor case. In FY 1987 the project will investigate how motor deformation during firing affects the combustion process and performance. Work will also begin on a fast-burning propellant for the Fast Launch Intercontential Ballistic Missile, a concept intended to improve survivability. Investigations will continue into the effects of processing variables on the integrity of composite motor cases and nozzles, and failure mechanics of two- and three-directional, filament-wound materials. In FY 1988 a small, mobile missile, service life program will begin to provide information to accurately predict the age life of motors. Additionally, test methods to validate full-scale motor performance at the subscale level will begin. FY 1989 efforts will include developing non-destructive evaluation techniques to detect motor flaws to prevent serious failures during firing, new processing techniques to eliminate motor processing variables, and demonstration of new propellants and components for advanced ballistic missiles.

C. (U) Project: 3148, Air-Launched Missile Propulsion Technology. This technology can be applied to both strategic and tactical missiles. Tactical applications concentrate on improving motor performance and operational flexibility to increase the probability of kill and minimize the visible rocket plume. Strategic applications strive to maximize stand-off range to improve aircraft survivability and weapons penetration to the target through the use of variable-trajectory capability. For tactical systems, the feasibility of a new, high-performance, low-cost polymer has been demonstrated for reduced and minimum-smoke propellants. This new polymer can provide minimum-smoke, low-hazard propellants without the performance degradation usually associated with minimum-smoke propellants. These low-hazard, high-performance propellants have great utility in Europe where safety requirements for missile storage seriously impact operations and on-hand quantities when high-hazard munitions are used. In FY 1986, a contract began to investigate non-circular composite motor cases. Requirements for pulse motors for very high altitude targets and strategic missiles that must penetrate defenses or maneuver for relocatable targets may demand non-circular motor cases and propellants that deliver very high thrust with low plume radar signatures. A joint effort started with Ogden Air Logistics Center to experimentally verify service life prediction programs by accelerating the age of newer motors in the laboratory to match older motors and then confirm the results by dissecting and testing the propellant from both motors. Also, high temperature resins were demonstrated that are suitable for further development in composite motor cases that can maintain structural capability during sustained supersonic flight conditions on high performance aircraft. Goals for FY 1987 include an experimental motor demonstration of a low-hazard minimum-smoke propellant suitable for air-to-air missiles. In FY 1988, propellant programs will begin that will improve the energy content usually forfeited in minimum-smoke propellants. Also beginning is work to assess how the combined effects of handling, accidental damage, and environmental conditions affect the service life of motors with composite cases. FY 1989 efforts will continue to improve the performance of motors and to transition technology for non-circular motor

cases, high-pressure propellants, and increased motor life to a prototype demonstration program. Also demonstrations of non-destructive evaluation techniques will provide validated improvements for motor processing.

D. (U) Project: 5730, Multiple Applications Technology. This project provides technologies that have applications to more than one area of propulsion. Techniques are needed to improve systems reliability by alleviating failures or low performance in systems such as solid propellant motors for orbit transfer systems and air-launched or ballistic missile motors. The technologies include better understanding of the effects of combustion on performance, introducing new propellant ingredients, determining factors influencing service life, and investigating the feasibility of advanced propulsion concepts. New concepts and innovative approaches to propulsion needs are a major focus of this project. The accomplishments in FY 1986 advanced a new propulsion concept (solar rocket) and a new propellant ingredient. In addition, work began in High-Energy-Density Propellants, a field which offers tremendous advances in propellant performance. These propellants could revolutionize the propulsion performance of conventional chemical systems with excited-state propellants that could double the payload of current space launch vehicles. A solar rocket experimentation facility was completed that allows testing of solar/thermal propulsion systems that could be used to provide reusable orbit transfer vehicles. A new propellant ingredient resulted in a proof-of-concept demonstration that could lower propellant ingredient cost by 30 percent and reduce sharply production cost through the use of new propellants. Improvements to the quality of a new polymer at the pilot plant scale, enabled consideration of this polymer for high-energy propellants in ballistic missiles and low-hazard, minimum-smoke propellants for air-launched motors. In FY 1987 work will continue on High-Energy-Density Propellants to study the theory and methods of creating materials in an excited-energy state. Work will begin in order to provide improvements in liquid propellant rocket engines and composite-case solid rocket motors. Flow of hot exhaust gas and cooling of rocket nozzles will be studied to improve the performance of propulsion for orbit transfer vehicles. Better understanding of flexible cases for solid rocket motors will allow a greater amount of propellant to be loaded into motors and better predictions of service life. FY 1988 work includes completing fundamental research to define processing, curing, and aging interactions of solid propellants. High-Energy-Density Propellant work will progress from the phase that concentrates on creating excited state materials to the phase that begins to develop the processes necessary to store these materials until they can be used in a propulsion system. In FY 1989 tests to confirm the predictive analysis of combustion instability will provide a tool to avoid serious problems during solid rocket motor firings. Efforts will continue to improve the performance of components, propellants and the integrity of solid propellant rocket motors. Improvements in liquid engines, for cooling of rocket nozzles, will be incorporated in engines for orbit transfer vehicles. Progress in the verification of the stabilization processes for High-Energy-Density propellants may allow initial work on detailed characterization of candidate materials.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 06RL, Laboratory Operations

A. (U) Project Description: This project funds management and support of the Air Force Rocket Propulsion Laboratory (AFRPL), Edwards Air Force Base, CA. The AFRPL is responsible for exploratory and advanced development associated with propulsion for air-launched and ballistic missiles and space systems. This project provides support for an

in-house program covering the following areas: rocket propulsion phenomenology investigations, new concepts feasibility evaluation and systems support to Air Force Systems Command product divisions. It covers salary and travel of civilian scientists, engineers and supporting personnel; transportation, rent, communications and utilities costs; and procurement of supplies, equipment, and contractor support services. This project supports and complements all projects in this program element.

B. (U) Program Accomplishments and Future Efforts: Not applicable.

C. (U) Major Milestones: Not applicable.

9. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3058, Space Propulsion Technology.

A. (U) Project Description: This project will provide technology required for: survivable, reliable operations in space in both routine and war-fighting scenarios; cost-effective access to all orbits; and survivable on-demand access to space. Areas of investigation include propulsion for satellite orbit transfer and maneuvering for survivability, launch vehicle propulsion, and exhaust plume signatures technology. Work will continue on technology to lower engine weight to reduce the cost-to-orbit and to develop engine condition monitoring that enables automated checkout, lower operations cost, and reusable systems. Better condition monitoring and longevity-extending technologies will allow reusability and will enable flexible operational concepts such as space basing.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Major feasibility demonstrations were conducted that apply to launch vehicles and three orbit-transfer propulsion systems. Advanced materials applied to launch vehicle engines and feed systems can save 15 percent of the engine weight. This could translate to an increase in Shuttle payloads of 6 percent for an Eastern-Test-Range launch or 12 percent for a Western-Test-Range launch. A low-thrust, cryogenic-propellant engine program was started that will verify component performance for orbit transfer propulsion for fragile space structures. Integrated thermal testing of a compact cryogenic-propellant feed system was completed that could provide a 30 percent increase of Shuttle payload volume over the modified Centaur by shortening the propulsion stage length. Initial testing of an arcjet thruster (electric propulsion device) demonstrated a 236 percent life improvement over previous designs, making it a viable candidate for orbit transfers of satellites with large power-generation capability. These results will be used to demonstrate performance increases in a representative size (30 kilowatt) engine. Also completed was the hot firing, breadboard engine demonstration of a modular storable propulsion system for satellite propulsion. The term modular refers to the ability to cluster any number of engines needed in a separate stage or to imbed them in the satellite, and the term storable refers to the propellants that can be stored indefinitely.

(2) (U) FY 1987 Program: Work will continue to reduce engine weight and demonstrate new propulsion concepts

such as arcjets, solar/thermal engines, and nuclear engines. Component design will be completed for the low-thrust cryogenic engine in preparation for testing. Extremely high performance engine nozzles for cryogenic and storable propellant engines will be demonstrated for a variety of satellite orbit transfer missions. An advanced arcjet engine design will demonstrate ten times the lifetime of the previous version and upgrade the performance of critical components. Completion of new laboratory facilities allows component demonstrations of solar collectors and solar/thermal thrust chambers for satellite orbit transfer propulsion. Studies will continue to define a nuclear propulsion system that could be used for reusable orbit transfer propulsion.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The previous year's efforts will continue and technology programs will start that will provide improvements to cryogenic and storable-propellant engines to achieve the high degree of reusability necessary for space-based operations. Work will be completed on feed systems for storable propellants and cryogenic propellants for satellite orbit transfer propulsion. Progress on arcjet thrusters will include completion of work on power conditioning circuit and key thruster elements to allow complete breadboard engine firings at 30 kilowatts. Launch vehicle engine technology programs will conclude, providing light-weight engine components to reduce engine weight.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Work in advanced space propulsion will include initiation of development efforts for a test bed engine for an advanced launch-vehicle engine and an advanced satellite maneuvering engine. Large, low-cost titanium tanks for storable propellants will be demonstrated that will enable weight reductions for propellant feed systems for satellite propulsion. Lightweight engine component technology for launch vehicles will be integrated in an ultra lightweight engine program that will demonstrate the feasibility of a new class of engines. Studies will begin to identify low-cost, expendable engine concepts that may provide an economic alternative to high-unit cost, reusable engines for launch vehicles. In addition, efforts will continue to transition solar/thermal engines, arcjet thrusters, and nuclear propulsion to advanced technology demonstrations for orbit-transfer propulsion. The 30 kilowatt arcjet thrusters will be demonstrated at the component level and transfered to an advanced technology demonstration of complete engine technology for reusable satellite propulsion and maneuvering.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not applicable.

10. (U) COOPERATIVE AGREEMENTS: Not applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62601F — Title: Advanced Weapons
DOD Mission Area: 521 - Electronics & Physical Sciences (ED) — Budget Activity: 1 - Technology Base

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		35,584	35,076	37,027	37,304	Continuing	N/A
06WL	Lab Operations	17,095	17,834	18,515	18,887	Continuing	N/A
2007	Nuclear Safety	755	800	740	850	Continuing	N/A
2218	DEW Tech Assessment	1,755	1,800	1,800	2,100	Continuing	N/A
3326	Laser Applications	6,690	6,662	6,472	7,080	Continuing	N/A
5797	Adv Weapons Concept	6,804	5,630	7,500	6,050	Continuing	N/A
8809	Nuc Surviv/Hard Tec	2,485	2,350	2,000	2,337	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Science and Technology effort advances the state of the art in directed energy weapons (DEWs) such as high energy lasers and high power microwaves and in nuclear survivability. These technologies will be used not only for weaponization but also to determine the effects of these types of weapons on potential targets. DEWs are of great interest because they will allow long range, near instantaneous kills of many types of targets. This technical effort will also support safety studies to ensure that our nuclear weapons can be handled and operated safely. Management and support of the Air Force Weapons Laboratory at Kirtland Air Force Base, NM, is also included. The efforts contained in this program do not duplicate tasks being conducted under the Strategic Defense Initiative or by the Defense Nuclear Agency.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	37,020	43,352	41,204	N/A	Continuing	N/A

EXPLANATION: (U) FY 1986 and FY 1987 reflects Congressional actions. The FY 1988 difference is due to Science and Technology Total Obligation Authority reductions.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
Military Construction Funds:	0	8,650	7,400	10,900	Continuing	N/A

5. (U) RELATED ACTIVITIES: Nuclear weapons efforts are coordinated closely with programs funded by the Defense Nuclear Agency PE 62715H. Technology developed through this program element supports nuclear survivability work for Advanced Strategic Missile Systems, PE 63311F, and Air Force Systems Survivability (Nuclear Effects), PE 64711F. Beginning in FY 1989, appropriate nuclear weapons efforts technology will transition to new projects in PE 63605F.

Exploratory laser development supports the Air Force Advanced Weapon Technology PE 63605F. Project 3326 and Project 5797 are coordinated closely with Navy PE 62101N, Directed Energy Weapons, and Army PE 62307A, Laser Weapon Technology. Within Project 5797, the High Power Microwave (HPM) program is closely coordinated with Air Force PEs: PE 62202F, Aerospace Biotechnology; 62204F, Aerospace Avionics; 63743F, Electronic Combat; PE 63749F, Command, Control, and Communications, Countermeasures Advanced Systems; 64711F, Systems Survivability; and 64747F, Electromagnetic Radiation Test Facilities. Beginning in FY 1988, applicable HPM technology development will transition to PE 63605F. There is close coordination between this PE and Directed Energy Weapons, Strategic Defense Initiative (SDI) PE 63221C. Project 2218 is coordinated with lethality and target hardening work in SDI 63224C, Survivability, Lethality, and Key Technologies. This coordination ensures that the Air Force makes maximum use of SDI technology applicable to non-SDI Air Force efforts.

6. (U) WORK PERFORMED BY: The Air Force Weapons Laboratory (AFWL) at Kirtland Air Force Base, NM, manages all of the work performed under this PE. The top five contractors for FY 1986 were RDA, Marina Del Rey, CA (8809); Computer Science Corp, Systems Division, Albuquerque, NM (8809); Ktech Corp, Albuquerque, NM (8809); Rockwell International Corp, Rocketdyne Division, Canoga Park, CA (5797); and Science Applications International Corp, McLean, VA (5797). There are 14 additional contractors with a contract value of $5.1 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 2007, Nuclear Safety. This project verifies designs of new and modified nuclear weapon systems against Air Force nuclear safety and security design criteria; maintains a technology base and develops nuclear safety and security design and evaluation criteria; and provides a technical nuclear safety analysis (TNSA) for each Nuclear Weapon System Safety Study. It also supports safety requirements for other uses of nuclear materials by the Air Force and provides technical assistance to other major commands to determine if the design or modification of a nuclear weapon system affects positive control of nuclear materials. System nuclear safety and security studies are performed in phases as the system develops and changes over its lifetime. Preoperational TNSAs are performed prior to system Initial Operational Capability. Operational TNSAs are performed as the system reaches Full Operational Capability. Nuclear certified systems undergo an operational nuclear safety and security review and inspection every two years. In FY 1986, preliminary special studies were performed on the F-16 A and B models, Minuteman warhead transportation system, and the F-111E. Preoperational studies were performed on the B-52 modification for the Advanced Cruise Missile, B-1B bomber and PEACEKEEPER missile system, and an operational review was conducted on the PA-200 TORANADO aircraft system. In FY 1987, special safety studies will be performed on the B-52H, F-16 A/B/C/D and F-111E aircraft systems. In FY 1987, safety analysis reports for current USAF reactor designs will be assessed, and reentry hazards associated with space reactors will be evaluated. Activities for FY 1988 include an initial nuclear safety study on the Small Intercontinental Ballistic Missile system and operational nuclear safety reviews and inspection of the Ground Launched Cruise Missile system, FB-111, F-16C/D and B-1B aircraft systems, and the PEACEKEEPER missile system. In FY 1989, planned efforts include the initial nuclear safety study on the Short Range Attack Missile II system and operation reviews and inspections of the B-52 Advanced Cruise Missile system, F-16A/B, F-111E, and PA-200 TORANADO aircraft systems.

Program Element: 62601F Title: Advanced Weapons
DOD Mission Area: 521 - Electronics & Physical Sciences (ED) Budget Activity: 1 - Technology Base

B. (U) Project: 2218, Directed Energy Weapon Technology Assessment. This project assesses directed energy weapons (DEW) lethality and DEW vulnerability of United States strategic and tactical systems. It further investigates systems assessment for DEW system employment. This project quantifies the vulnerability of US weapon systems to DEWs and provides a technology assessment of operational practicality of DEWs for specific Air Force missions. The lethality assessment effort includes theoretical and experimental work with a variety of materials and countermeasures concepts. The systems assessment effort plans, coordinates, and performs studies and analyses of DEW concepts in order to establish system performance characteristics and requirements. This includes examination of potential applications and the determination of feasibility and effectiveness of mission performance. Preliminary engineering studies are performed on advanced weapons concepts to determine impact on subsystem and component technology development. The systems analysis effort investigates how to best utilize DEWs and determine what technology improvements are required. During FY 1986, laser lethality was established experimentally against satellite pressure vessels and components. Ongoing laser material interaction studies provided a basis for the development of scaling laws for larger spot sizes, higher intensities, shorter wavelength and differing waveforms. A reliable 40 kilowatt carbon dioxide laser was fabricated as a tool for lethality testing. Vortex quartz lamp tests showed that these lamps can be used as low cost laser simulators in certain applications. High energy laser system modeling continued with code releases, system analyses, phenomenology investigations and cost modeling. Three codes were released for modeling laser weapon systems. Two studies were completed for analyzing laser system performance in strategic and tactical scenarios. Three phenomenology studies were completed for thermal blooming and boundary layer turbulence. Neutral particle beam studies were initiated to investigate kill mechanisms in electronic components. A high power microwave (HPM) methodology for testing United States and foreign satellites and tactical aerospace systems was initiated in coordination with other national agencies. Protocol for HPM phenomenology testing was drafted and six generic test objects were fabricated to support lethality studies. The Tactical Microwave Energy Weapon Code was delivered and later modified to support studies on strategic relocatable targets; further use will investigate optimum altitudes for airborne and unmanned microwave weapons. Analytical modeling of material damage caused by lasers will receive continued emphasis through FY 1989. A Ground Based Laser Uplink Study will be completed in FY 1987. A cost model will be completed in FY 1987 to integrate the capability of Phased Integrated Laser Optics Technology in future system assessment models. Weight and volume models for oxygen iodide lasers will also be completed in FY 1987. In FY 1988, work on phenomenology models for existing laser codes will conclude. HPM assessments will continue through FY 1989 on United States and foreign tactical systems. Work will continue on modeling high power microwave propagation for possible tactical microwave weapons. Initial particle beam phenomenology and computer modeling will be developed through FY 1989. Plasma jet weapons concept studies will begin in FY 1987 and transition to lethality testing in FY 1989.

C. (U) Project: 3326, Laser Applications. This project develops the technical feasibility of lasers as weapons for Air Force mission requirements. It emphasizes advanced, high-payoff technology concepts and high energy laser (HEL) processes for substantial improvements in these systems. This includes studying short wavelength chemical laser device concepts, developing fabrication technology for HEL optical components, analyzing and investigating advanced beam control and beam generation concepts, and investigating HEL phenomenology. Advanced chemical lasers may provide an attractive, high efficiency alternative for airborne, space based and ground based systems. A revolutionary technique for single pulse operation of a chemical oxygen iodine laser was demonstrated in FY 1986. This will lead to a repetitively pulsed demonstration which will be completed in FY 1987. This effort will then transition to PE 63605F Advanced Radiation Tech-

nology, for scaling demonstrations. Promising concepts for visible wavelength chemical lasers have been identified and are being pursued theoretically and through in-house experiments. A visible chemical laser demonstration is anticipated in FY 1988, with subsequent scaling to the one kilowatt power level in FY 1989/1990. Investigation of electroform replication for mass producing high quality optics leading to a potentially cheaper, faster method of fabricating optical components will be completed in FY 1987 with the fabrication of eight inch mirrors. Development of optical components for short wavelength/near infrared lasers will continue. One of the most critical needs is to be able to quickly correct the laser beam for any nonuniformities caused by the lasing medium, nonperfect mirrors, moving mirrors, etc. Several techniques are being studied. Feasibility investigations of an optically addresed deformable mirror will be completed in FY 1987 with the fabrication and evaluation of a few actuator test samples. If promising, this concept will be pursued with the fabrication of a 100-200 actuator mirror in FY 1988. The best technologies will then be integrated into Air Force laser and imaging breadboards in FY 1989. A revolutionary concept for beam correction, as well as several other related applications, such as beam pointing/steering, combining several beams into a single beam, and incorporating information onto the beam, is being developed. This concept is nonlinear optics. The investigation of nonlinear optics technology will build on the FY 1986 accomplished conceptual demonstrations of beam steering and beam sharpening. These demonstrations will transition to PE 63605F, Advanced Weapon Technology, in FY 1988.

D. (U) Project: 5797, Advanced Weapons Concepts. This project explores nonconventional, nonnuclear and nuclear weapons concepts using innovative technologies. Primary areas of research are high power microwaves (HPM), high energy plasmas, high energy pulse power, nuclear power technology, and conceptual and feasibility studies of nuclear weapons requirements. High Power Microwaves: During FY 1986 the Air Force High Power Microwave Technology program was established. FY 1986 activities included research on device development technology, upgrading test environments/facilities to provide controlled, reproducible electromagnetic fields, expanded effects database development in conjunction with the national HPM testing community; efforts to develop a standard test methodology; and research in several areas of phenomenology. Major efforts were also initiated to identify and obtain test assets suitable for HPM testing at current facilities. Planned activities for FY 1987, in addition to continuation of the FY 1986 efforts, include establishment of a USAF HPM Test Advisory Group to review all aspects of the upcoming series of major subsystem and system tests that support susceptibility/vulnerability database development, pre-test analysis as well as post-test analysis for these systems tests; investigation of hardening technologies; tests of selected foreign assets; and lethality experiments. Among the assets to be tested in FY 1987 are AIM-9L, AIM-9P, AIM-7, selected communication subsystems, and the Air-Launched Cruise Missile (ALCM) radar altimeter. Selected system concept and analysis studies will be initiated. Higher efficiency devices developed during FY 1987 (power outputs as high as 5 Gigawatts) will allow larger systems to be tested in late FY 1987 and FY 1988. Investigation of phase locking of multiple HPM sources, antenna coupling and propagation issues will also be conducted. During FY 1988 increasingly larger, more complex Air Force systems will be tested to add to the national vulnerability database. In FY 1989, with the completion of the HPM Test Laboratory, aircraft-sized assets will be tested as will hardened systems. High Energy Pulse Power: In FY 1986 efforts began on a long pulse (microsecond) transformer system to provide power conditioning for an explosive generator. This system will be tested in FY 1987 as a potential power source for a compact HPM generator. High energy density plasma flow switch experiments, to be used in advanced intense microwave production, conducted on the SHIVA STAR capacitor bank in FY 1986 will continue in FY 1987. High Energy Plasma: Using the high energy density capacitor banks, solid metal jets, propagating at several tens of kilometers per second, were produced during FY 1986. This research, with

possible application as ultrahard target penetrators, will continue through FY 1988. Detailed investigation of the production, acceleration, propagation and material interactions of ultrahigh velocity plasma streams, begun in FY 1986, will continue through FY 1989. Nuclear Power Technology: In FY 1986 work was completed on a radiation shielding code and a kinetic model for control of space nuclear reactors. Terrestrial and space nuclear reactor program studies will continue during FY 1987 as will modeling studies of reactor thermodynamics and kinetics for advanced reactor design concepts. FY 1987 efforts in advanced nuclear power technology will include investigations using liquid metals. In FY 1988 and FY 1989 space nuclear reactor systems concepts will be developed. Intense Relativistic Electron Beam: A major milestone in the national charged particle beam research was achieved in FY 1986 when, for the first time, an intense relativistic electron beam was extracted from the Radial Line Accelerator and propagated stably in open air. Air Force funding for this program terminated in FY 1986. Subsequent investigations in FY 1987 will be funded by the Defense Advanced Research Projects Agency. Nuclear Weapons Requirements Studies: Nuclear weapons requirements studies completed in FY 1986 include a conceptual study for hard target kill (HTK) weapons and feasibility studies on the Short Range Attack Missile warhead and the Advanced Intercontinental/Small Ballistic Missile (ICBM) warhead. Activities starting in FY 1986 and finishing in FY 1987 include conceptual studies on Strategic Relocatable Target weapons using both conventional and advanced nuclear effects as well as feasibility studies for alternative warheads for the Small ICBM and for HTK weapons. Two, as of yet undefined, conceptual studies will be initiated in FY 1988. In FY 1989 three nuclear weapons requirements studies will be conducted.

E. (U) Project: 8809, Nuclear Survivability and Hardening Technology. This project develops nuclear survivability technology for Air Force systems. This includes design criteria, specifications, standards and design handbooks, and methods to alleviate the effects of nuclear weapons on Air Force systems. Nuclear survivability criteria set the upper limits of nuclear environments in which Air Force systems must survive and are based on mission requirements, hostile threats, nuclear environment system response, operational employment, hardening technology and cost factors. In FY 1986, criteria development was completed for the Milstar ground terminal and Satellite link; Small Intercontinental Ballistic Missile, including its hard mobile launcher and control system; Short Range Attack Missile II; Mission Effective Information Transmission System; and the Air Force One replacement. The first draft of a North Atlantic Treaty Organization document describing methodology for aircraft systems was completed in FY 1986. In FY 1986, the AF Manual for the Design and Analysis of Hardened Structures was updated. This update has a fully documented section on nuclear cratering and ground shock prediction methodology. Nuclear radiation characterization of Ground Launched Cruise Missile and North Atlantic Treaty Organization fiber optics was completed in FY 1986. Investigations of nuclear radiation effects in advanced electronic components were conducted in FY 1986. In FY 1987, techniques will be developed to predict the recovery of semiconductor devices from radiation damage in the low dose rate, low temperature space environment. During FY 1987 through FY 1989, advances in hardened structural analysis, including superhard silo, mobile launcher and control vehicle technology, will be included in the design manual. Also during FY 1987, nuclear criteria will be completed for the KC-10 Tanker Single Integrated Operation Plan (SIOP) mission, EC-XX Airborne Command Post, Survivable Enduring Command and Control Center, and the Advanced Tactical Fighter. Testing to determine thermal degradation of advanced composite materials will continue in FY 1987. These tests will be conducted at the White Sands Missile Range Solar Facility using simulated nuclear thermal radiation. Nuclear systems survivability studies which started in FY 1986 will continue on through FY 1992. These studies will investigate alternate concepts to define, develop, and establish the requirements for present and future Air Force weapon systems. Resulting requirements will enhance

system performance in critical missions. Radiation tests are planned in FY 1987 and 1988 on emerging semiconductor devices for use in advanced Air Force systems. The internal monitoring system to measure high energy electric discharges will be delivered in FY 1987 for flight on the Combined Release and Radiation Effects Spacecraft in FY 1989. New methods will be developed to assist in the definition, development, and establishment of hardness requirements for nuclear blast, thermal and radiation effects on present and future Air Force weapon systems. The goal will be to enhance our weapon systems' performance in critical missions. In FY 1988 work will continue on defining advanced structural materials for nuclear hardening and determining the effects of nearby nuclear detonation on structures. New analytical methods that incorporate these efforts will be explored. Nuclear criteria studies planned for FY 1988 include the following systems: Advanced Close Air Support Aircraft; Ground Wave Emergency Network; Tactical Fighters such as the F-16, F-15, A-10, F-111; Interservice/Agency Automatic Message Processing Exchange; and new Tactical Air Command and Strategic Air Command reconnaissance aircraft and satellites. In FY 1988 and FY 1989, radiation damage mechanisms important for low temperature microelectronics applications, such as infrared sensors, will be studied. Our current space nuclear environment predictive capability is very uncertain. With the increasing emphasis being placed on advanced systems for enhanced nuclear survivability these uncertainties must be greatly reduced. New models for nuclear effects in space will be developed during the period FY 1988 through FY 1989 to alleviate this problem. In FY 1989 nuclear criteria studies will include the update of the KC-135 Tanker Single Integrated Operation Plan, National Aerospace Plane/Boost Glide Vehicle, and Advanced Time Sensitive Communication Systems. Space irradiated integrated optics will be deployed as space shuttle experiments in FY 1989/1990.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 06WL, Laboratory Operations

A. (U) Project Description: This project covers management and support of the Air Force Weapons Laboratory (AFWL), Kirtland Air Force Base, NM. The AFWL is responsible for exploratory, advanced, and engineering development programs associated with nuclear and other nonconventional advanced weapons, including studies of effective delivery techniques and hazards of these weapons. This project provides for the pay and related costs of civilian scientists, engineers, and supporting personnel in the AFWL; travel and other transportation costs; costs for AFWL personnel training, facility projects, and communication lines; rental and maintenance costs for administrative equipment; nontechnical contractual services; and procurement of administrative supplies and equipment. This project supports and complements all other projects in this program element.

B. (U) Program Accomplishments and Future Efforts: Not Applicable.

C. (U) Major Milestones: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62602F
DOD Mission Area: 523 - Engineering Technology (ED)

Title: Conventional Munitions
Budget Activity: 1 - Technology Base

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	38,585	39,621	43,041	46,846	Continuing	N/A
06AL	AF Armament Laboratory Operations	10,970	12,118	12,268	12,320	Continuing	N/A
2068	Advanced Seeker Technology	7,810	9,590	12,126	14,600	Continuing	N/A
2502	Ordnance Technology	10,476	11,262	11,442	11,768	Continuing	N/A
2543	Weapon Effectiveness Methodology	3,114	2,382	2,576	2,813	Continuing	N/A
2567	Aeromechanics Technology	5,948	4,169	4,629	5,345	Continuing	N/A
2946	Chemical Warfare Technology	267	100	0	0	0	2,800

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Science and Technology effort advances the AF technology base for air-delivered conventional weapons to support the nonnuclear missions of the Tactical Air Forces, Strategic Air Command, and the Special Operations Forces. The program includes: (1) design and demonstration of advanced air-delivered munitions, warheads, explosives, and fuzes; (2) guidance and flight control to assure weapon delivery; (3) improved aircraft guns and ammunition; (4) advanced low-drag high performance airframes, conformal/internal carriage techniques, and improved submunition dispensing concepts, and (5) modeling, analyses, and evaluation criteria for all efforts. This program also funds the management and support of the AF Armament Laboratory at Eglin AFB, FL, and provides fiscal support for the Joint Service Guidance and Control Committee and the Joint Army/Navy/NASA/AF Interagency Propulsion Committee.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	41,230	49,884	49,634	N/A	Continuing	N/A

EXPLANATION: (U) The FY 1986 funds were reduced by Gramm-Rudman-Hollings and Air Force requirements. FY 1987 program funds were reduced by Congress. FY 1988 program reflects Air Force Total Obligation Authority reduction.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
Military Construction Funds	5,000	0	0	0	Continuing	N/A

5. (U) RELATED ACTIVITIES: This is the only AF exploratory development program that provides the conventional munition technology base for the following AF advanced and full scale development programs: 63307F, Air Base Survivability; 63601F, Conventional Weapons Technology; 63363F, Hypervelocity Missile/Advanced Missile Technology Integration; 63609F,

Millimeter Wave Seekers; 64314F, Advanced Medium Range Air-to-Air Missile; 64602F, Armament Ordnance Development; 64604F, Submunitions Development; 64609F, Reliability & Maintainability Maturation/Technology Insertion; 62201F, Aerospace Flight Dynamics; and 64733F, Surface Defense Suppression. Related Army, Navy and Defense Advanced Research Projects Agency (DARPA) programs include: 62303A, Missile Technology; 62624A, Weapons and Munitions Technology; 62618A, Ballistic Technology; 62332N, Surface/Aerospace Weapons Technology; and 62702F, Tactical Technology. These related programs are coordinated through formal and informal channels to prevent unnecessary duplication and to maximize the payoff from research and development expenditures. Formal coordination of efforts within these programs has been through Memoranda of Understanding and Agreement with the Air Force Weapons Laboratory, Air Force Wright Aeronautical Laboratories, Air Force Engineering Services Center, Army Missile Command, Naval Weapons Center, Naval Air Systems Command, and DARPA. Additional coordination is accomplished through participation in the following joint service groups: Joint Ordnance Commander's Group, Joint Director of Laboratories Committee, Joint Service Fuze Manager, Joint Service Seeker Working Group, Technical Coordination Program, Tri-Service/Industry Infrared Working Group, Joint Service Guidance and Control Committee, and Joint Conventional Ammunition Program.

6. (U) WORK PERFORMED BY: This program is managed by the Air Force Armament Laboratory, Eglin Air Force Base, FL. The major contractors are: Vought Corp, Dallas, TX (Projects 2068, 2502, and 2567); Raytheon Co, Bedford, MA (Project 2068), General Electric Co, Schenectady, NY (Project 2502); McDonell Douglas Astronautics, St Louis, MO (Project 2567); and Lockheed, Sunnyvale, CA (Project 2502). There are 36 additional contractors with a dollar value of $62.3 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 2543, Weapon Effectiveness Methodology. This project develops and uses computational techniques and data bases to assess weapon effectiveness against aircraft, mobile targets such as tanks and armored personnel carriers (APC), and fixed hardened targets such as bunkers and shelters. In FY 1986, this project initiated updating physical and functional descriptions of advanced Soviet aircraft and various Pacific Air Force (PACAF) targets for use in weapon effectiveness models. The project continued vulnerability studies for Soviet surface-to-air missile (SAM) systems and began a vulnerability study of PACAF structures to cratering and penetrating bombs. FY 1987 efforts will complete the vulnerability of the Soviet FULCRUM fighter and implement physical and functional descriptions of the Soviet cruise missile, the Airborne Warning and Control System aircraft, and the FENCER fighter/bomber. Studies will be completed on the SA-8 radar and the SA-11 SAM systems. SA-10 and SA-12 SAM systems vulnerability studies will continue. Target descriptions and vulnerability assessments will be completed for the North Korean command centers and SAM sites. Vulnerability and effectiveness studies will be conducted for the hard target weapon against several hardened command centers and bridges. Physical and functional descriptions of North Korean SAM sites and support facilities, hardened artillery sites and naval facilities will be implemented. In FY 1988, threat descriptions will continue for the Soviet Peripheral Attack Aircraft, FROGFOOT fighter, and the transatmospheric vehicle (TAV). Fixed, hardened-target studies will continue vulnerability assessments of PACAF targets, including cave-type aircraft shelters and maintenance areas, and underground gun emplacements. FY 1989 efforts will complete the assessments of the Peripheral Attack Aircraft and FROGFOOT. Work on the TAV will continue. Studies will be completed on the Soviet advanced APC and the highly mobile combat vehicle. Results of test programs using Australian concrete structures, and bomb tests against full-size buildings will be incorporated into vulnerability models.

B. (U) Project: 2567, Aeromechanics Technology. This project develops weapon airframe and carriage technology for streamlined weapons. Streamlining weapons improve aircraft performance by reducing drag caused from attaching weapons to aircraft. Developments will also enable supersonic, low-altitude weapon releases that will greatly increase aircraft survivability. This project also provides the technology base supporting low-cost, small-size, midcourse guidance subsystems for standoff weapons. In FY 1986, breadboard dispensing mechanisms were fabricated, and their performance in high-speed sled tests was evaluated. Lightweight, low-drag missile airframe designs were evaluated in wind tunnel and sled tests. The Joint Service Tactical Ring Laser Gyro effort continued development of a smaller, more accurate gyro for missiles. The project also evolved quicker, more efficient alignment and calibration methods for tactical weapon inertial navigation systems and initiated artificial intelligence applications to tactical weapons. FY 1987 efforts will demonstrate low-drag, advanced missile airframes and will transition this technology to PE 63363F, Advanced Missile Technology Integration Program. Weapon carriage and release technologies that focus on lighter, lower cost, lower maintenance components will be developed and incorporated into conformal/internal ejector racks to increase rack performance and reliability. Small, low-cost solid state gyro and accelerometer technology will mature for integration into weapon guidance and flight controls. Distributed system software techniques to increase data processing capacities while reducing size, weight and cost of internal processing hardware will be investigated. FY 1988 efforts will demonstrate advanced launchers that can eject missiles carried internally. Advanced weapon airframe technology for efficient hypersonic flight at 100,000 to 400,000 feet will be initiated. The Joint Service tactical ring laser gyro inertial measurement unit (IMU) will be field tested to establish its effectiveness without increasing system costs. The project will also demonstrate techniques to enable faster, more accurate transfer of information between aircraft and missile inertial navigation systems. In FY 1989, the project will evaluate aerodynamic characteristics and develop the data base for advanced, highly maneuverable missile airframes. The project will improve models to assess and predict air flow fields for internal weapon bays and external wing pylons. The development of missile airframes capable of efficient hypersonic flight at 100,000 to 400,000 feet will continue. Brassboard development will be completed and a small, low-cost laser gyro IMU providing improved midcourse guidance accuracy at a 50 percent cost savings over current IMUs will be demonstrated. A low-cost, solid state sensor will be developed to reduce errors in inertial measurement alignments and improve missile midcourse guidance accuracy.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2068, Advanced Seeker Technology.

A. (U) Project Description: This project develops advanced seeker technology for conventional air-to-surface and air-to-air weapons and advances the technology base for autonomous, all-weather weapons delivery. This effort provides effective precision terminal guidance of advanced weapon systems with increased accuracy and standoff ranges, more precise aimpoint selection, offset aiming for buried hard targets, autonomous target acquisition and terminal guidance for a "launch and leave" capability. This project develops more cost-effective weapon systems by increasing the number of kills per sortie and increasing delivery aircraft survivability.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Real-time seeker analysis and evaluation capability were added to the infrared (IR) target simulator. Simulators reduce the risk and cost of developing and evaluating seekers and their components. Laser radar breadboards were tested and evaluated for their incorporation into a seeker package. The joint AF/Defense Advanced Research Projects Agency (DARPA) effort continued to develop millimeter wave (mmw) seeker algorithms for autonomous all-weather guidance against tactical targets. A low-cost solid state IR sensor for use in submunitions effort was initiated. The joint AF/Army development continued for a dual-mode mmw and IR seeker concept for autonomous all-weather target attack. This concept combines the precision of imaging IR technology with the adverse-weather capability of mmw technology to enable all-weather multi-mode guidance. Dual-mode systems are also more resistant to enemy countermeasures. Efforts were initiated to reduce the cost and increase the producibility of radio frequency seeker subsystems.

(2) (U) FY 1987 Program: The extended source IR target simulator that generates real-time dynamic IR scenes will be completed. A low-cost tactical laser radar guidance breadboard concept will be demonstrated in captive flight tests against high-value targets, such as airfields, bridges, industrial complexes, etc. The jointly funded AF/DARPA development of the mmw seeker algorithms will be completed and incorporated into an ongoing dual-mode seeker development effort with the Army. This will provide a dual-mode seeker concept capable of autonomous all-weather attack against fixed and mobile targets. Techniques to autonomously acquire future Warsaw Pact air threats will be identified (joint effort with the Navy). Promising techniques will be included in a breadboard seeker design to demonstrate their potential applications to future air-to-air missiles. Advanced weapon seeker radome and antenna technologies will be initiated to take advantage of monolithic designs being developed in basic research efforts.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The joint AF/Army dual-mode seeker concept will be tested and evaluated in laboratory and captive flight tests. This concept combines the precision of imaging IR with the adverse weather capability of mmw to enable all-weather, multimode guidance. These tests will validate mmw digital signature models for targets, background clutter, and countermeasures. These efforts will enhance the ability to predict threat signatures and are supported by joint AF/DARPA mmw seeker algorithm developments. A field demonstration of an AF/Navy breadboard seeker concept designed to provide future missiles with a capability against projected Warsaw Pact threats will begin. Efforts to incorporate artificial intelligence into guided weapons to improve their acquisition, classification, and identification of a broad range of targets will be initiated. Integration of multi-aperture optics and optical processing technologies to obtain sensors with larger fields of view and faster processing speeds will begin. This will allow higher speed and longer range missiles while eliminating costly components (such as gimbals and scanning mechanisms). Gallium arsenide 3-D ranging sensor technology for submunitions will be evaluated. Adding this accurate ranging capability to submunition sensors will increase target acquisition and optimize fuzing, thus increasing submunition effectiveness.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Development of an improved mmw seeker and application of the algorithms and technology advancements to obtain a lower cost, higher precision, all weather terminal guidance capability against mobile and fixed ground targets will be initiated. An advanced radome and receiver

design will be developed to provide dual-mode, multi-band radio frequency operation. This will provide missiles with a greater anti-jam capability, and expand their radiation homing capability to a broader target set. A brassboard test and evaluation of lower cost, higher reliability radio frequency seeker components will be conducted. These components could result in savings of $10,000 to $20,000 per unit of missile guidance systems. Breadboard demonstration of seeker designs effective against projected Soviet future threats will be completed. This cooperative effort with the Navy will provide the technological edge to maintain air superiority in future conflicts. The project will develop and demonstrate a gallium arsenide 3-D ranging sensor. This effort provides a low cost option that gives submunitions increased target acquisition range and improved fuzing control. Breadboard designs for the multi-aperture seeker will be completed. The project will demonstrate a noncooperative, high resolution scoring system that scores missiles and gunnery systems against air targets.

(5) (U) Program to Completion: This is a continuing project. All-weather seekers will be incorporated into conventional weapons and tactical laser radar will be integrated into weapon guidance packages to defeat high value targets.

C. (U) Major Milestones: Not applicable.

9. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2502, Ordnance Technology.

A. (U) Project Description: This project designs and demonstrates advanced air-launched weapons for increased lethality, multiple target kills and reduced delivery aircraft exposure. These efforts provide simulation and analysis of advanced concepts in cluster munitions, kill mechanisms, warheads, explosives, fuzing, and target activation technologies. This project also develops advanced aircraft guns, ammunition, and related component technologies for air-to-air and air-to-surface operations.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: An air-to-air reactive fragmentation warhead for enhanced lethality was designed and evaluated. Reactive fragments may increase weapon lethality by 3-5 times over standard weapons. High length-to-diameter heavy metal penetrating rods were developed to defeat advanced armor configurations. Subscale and full-scale warhead case tests and evaluations were conducted to verify designs for deep penetrating warheads used against complex, hardened, high-value underground targets. Penetration fuze technology was continued to design a fuze capable of defeating complex, buried, high value targets. Optical sensor algorithms were developed and incorporated into air-to-air proximity fuzes to achieve low-cost, all-weather fuzes for air-to-air missiles. An interim qualification test was conducted on an insensitive high explosive (IHE) formulation. IHE will increase safety and enable greater weapon storage density, thus improving logistics and enhancing our readiness posture, especially in Europe. Development of advanced barrel concepts and surface treatments that have potential high payoff for increasing barrel life in aircraft guns were continued.

(2) (U) FY 1987 Program: Explosively-formed penetrators and self-forging heavy metal fragments will be fabricated, tested, and evaluated against future Warsaw Pact threats, such as the T-80 follow-on tank. Model development for warhead/target interaction and resulting armor debris effects will continue. The breadboard fabrication, test, and evaluation of defense suppression submunitions and low-cost adverse weather optical proximity fuze designs will continue. Reactive fragmentation kill mechanisms will continue to be evaluated against various targets. The insensitive high explosive (IHE) efforts will be expanded to include submunitions and missiles. Development of high performance gun barrel concepts will continue. The penetration fuze technology will be tested and evaluated against complex, buried, high value targets. Electronic fuze breadboard designs used in high velocity projectiles will be tested and evaluated. New penetration techniques to defeat extremely hardened underground targets will be investigated.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Penetration mechanics to defeat buried hardened targets will be further investigated and characterized. Subscale tests of improved warhead cases will be conducted against concrete, rock, and rockrubble targets, and the results will provide the technology base to design warheads to defeat hardened Warsaw Pact targets. Laboratory and field tests will be conducted with shaped charges and pre-formed penetrators to evaluate advanced materials and improved heavy metal warhead designs. These results will characterize armor penetration properties and will be used to design anti-armor warheads effective against the T-80 follow-on tank. Sled tests of joint AF/Army developed reactive fragment warhead concepts will be conducted. The brassboard fabrication of the optical fuze will be completed, tested, and evaluated in the Navy Encounter Simulation Facility. Subscale qualification of candidate IHE formulations will be conducted and evaluated for transitioning to general purpose bombs. Burst-fire tests will be conducted with newly developed gun barrels which incorporate advanced materials and plating techniques for longer barrel life in higher velocity (5000 feet per second) gun systems.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Advanced penetration designs will be analyzed and evaluated to characterize effects against advanced armors. This effort will maintain US capability to defeat projected armor threats with air-launched weapons beyond the year 2000. Innovative techniques for maneuvering submunitions during free-flight will be demonstrated. Such techniques will increase the number of kills per cluster weapon, increasing the cost effectiveness of cluster weapons and reducing the number of sorties required to kill targets. Techniques to control trajectories of runway penetrating bombs will be investigated to improve penetration and cratering. High performance gun barrels will be developed and demonstrated. Finally, material fracture effects during warhead impact and penetration will be investigated to develop the capability to defeat advanced armor.

(5) (U) Program to Completion: This is a continuing project. IHE will be qualified for missile warheads and transition to advanced development. Longer life gun barrels (5000 feet per second rounds) for advanced gun ammunition will be demonstrated. Free-flight maneuvering techniques and heavy metals will be incorporated into submunitions.

C. (U) Major Milestones: Not applicable.

Program Element: 62602F
DOD Mission Area: 523 - Engineering Technology (ED)

Title: Conventional Munitions
Budget Activity: 1 - Technology Base

10. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 06AL, Air Force Armament Laboratory Operations.

A. (U) Project Description: This project funds the management and support of the AF Armament Laboratory (AFATL), Eglin Air Force Base, FL. The AFATL is responsible for exploratory and advanced development associated with conventional weapons. This project provides support for in-house programs. It covers salaries of civilian scientists, engineers and support personnel; travel; transportation, rent, communications and utilities costs; procurement of supplies and equipment; and contractor support services. This project supports and complements all projects within this program element.

B. (U) Program Accomplishments and Future Efforts: Not applicable.

C. (U) Major Milestones: Not applicable.

11. (U) COOPERATIVE AGREEMENTS: Not applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 62702F
DOD Mission Area: 521 - Electronics and Physical Sciences (ED)

Title: Command, Control, and Communications
Budget Activity: 1 - Technology Base

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		72,760	75,819	82,260	84,061	Continuing	N/A
06RA	Laboratory Operations	34,825	35,800	39,778	40,219	Continuing	N/A
2338	Assurance Techniques for Electronics	4,770	5,790	5,242	5,210	Continuing	N/A
4506	Surveillance Technology	8,340	9,175	10,184	10,545	Continuing	N/A
4519	Communications Technology	4,932	4,810	5,172	5,355	Continuing	N/A
4594	Intelligence Technology	5,703	6,010	6,433	6,700	Continuing	N/A
4600	Electromagnetic Radiation, Devices and Components	6,370	6,345	6,848	7,120	Continuing	N/A
5581	Command & Control Technology	7,820	7,889	8,603	8,912	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Science and Technology program advances Air Force mission capabilities in Command, Control, Communications and Intelligence (C^3I). Current operational requirements include: increasing the operational availability of C^3I systems through improved reliability and maintainability of electronic components and systems; improving the effectiveness and survivability of C^3I systems through reliable and secure communications; improving surveillance range and detection capabilities against both low observable threats and enemy electronic countermeasures; and improving the timeliness and quality of intelligence data for decision making. Technical projects address six technology areas which advance the state-of-the-art in C^3I: electronic reliability/maintainability and electromagnetic compatibility; surveillance; communications; intelligence; electromagnetic radiation, devices and components; and information processing. The program element also provides for management and support of the Rome Air Development Center (RADC), Griffiss AFB, Rome, NY, with two divisions of RADC located at Hanscom AFB, MA.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	73,916	74,062	82,745	N/A	Continuing	N/A

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Military Construction: Funds	1,210	0	0	0	Continuing	N/A

5. (U) RELATED ACTIVITIES: This program is coordinated at Tri-Service and interagency levels to preclude duplication and to meet overall Department of Defense (DOD) needs in Command, Control, Communications and Intelligence related technologies. Examples of this coordination are the DOD Advisory Group on Electronic Devices, the Interservice Antenna Group, and the Radiation Hardened Electronics Technology Coordinating Group. DOD has fostered close coordination between the Services in several technology areas affecting this program, particularly in the surveillance and communications areas. Space Based Radar surveillance programs are closely planned with the Navy, and a joint technology coordination group was established in 1985. A Tri-Service Fiber Optic Coordinating Group chartered by the Office of the Under Secretary of Defense for Research and Engineering coordinates all fiber optics Science and Technology work (6.1, 6.2, and 6.3) and implements joint programs (funding, technical effort, and testing). Rome Air Development Center (RADC) chaired this group in 1986. Image exploitation programs are coordinated through a national committee, and the Defense Mapping Agency (DMA) coordinates all Service programs in mapping and charting. The National Security Agency coordinates all Service programs in signals intelligence and computer security. The Defense Intelligence Agency coordinates Service programs in intelligence data handling. The technologies developed in this PE transition to the following Program Elements for advanced development: PE 63728F, Advanced Computer Technology; PE 63789F, Command, Control and Communications Advanced Development; PE 63726F, Fiber Optics Development; PE 63259F, Cartographic Applications for Tactical and Strategic Systems; PE 63701B, DMA Advanced Development; PE 63738F, Air Defense Initiative Surveillance Technology; PE 63743F, Electronic Combat; and PE 63106F, Logistics Systems Technology.

6. (U) WORK PERFORMED BY: This program is managed by RADC, Griffiss AFB, NY. The top five contractors are: Eaton Corp., West Lake Village, CA (06RA); PAR Technology Corp., Utica, NY (5581); Watkins-Johnson Co., San Jose, CA (4508); Eyring Research Institute, Provo, UT (4519); and General Electric Company, Syracuse, NY (4506). There are 82 additional contractors, and the total dollar amount of the additional contracts is $39 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 2338, Assurance Techniques for Electronics. This project provides technology which increases reliability and maintainability (R&M) for electronic devices and systems while assuring electromagnetic compatibility. Payoffs include increased system availability and lower life cycle costs with systems having higher R&M. To improve electromagnetic compatibility, techniques to eliminate interference problems are necessary, particularly when smaller, densely packed radio frequency emitters are integrated in an aircraft. FY 1986 accomplishments include the development

of techniques for screening faulty electronic components. This was done by applying environmental stimuli to electronic hardware during the manufacturing cycle to discover latent defects which could then be addressed through proper repair techniques. Achievements also include development of failure rates for dormant electronic systems (systems stored in an inactive state for long periods of time), establishment of fundamental procedures to evaluate Monolithic Microwave Integrated Circuit (MMIC) performance when subjected to high levels of electromagnetic interference and the computer aided design and fabrication of test structures for use in the qualification of Very Large Scale Integration computer chips. In FY 1987, new technologies such as photonics and MMIC will be studied for reliability. Photonics is a high payoff technology where photons (optical systems) perform the functions normally done by electrons in electronic circuits. MMIC devices function as microwave circuits on integrated circuit chips. Both of these new technologies will require extensive reliability research. Other efforts will focus on fault tolerant systems. Plans for FY 1988 include increased emphasis on technologies that impact system reliability, fault tolerance, maintainability, cost, and performance. New efforts will develop computer aided engineering modules for designing in reliability at system and device levels. The application of artificial intelligence to built-in-test (BIT) technology will result in the development of computer modules for SMART BIT (i.e., BIT which can perform "intelligent" functions such as circuit reconfiguration to correct faults). Additional new starts will address the reliability and maintainability aspects of monolithic millimeter wave integrated circuit technology. Efforts will be completed in electromagnetic compatibility development for advanced modulation techniques. In FY 1989, plans call for the continued emphasis on improved reliability, fault tolerance, and maintainability for next generation advanced technology devices and systems. The feasibility and simulation of a number of promising reliability, maintainability, and technology concepts will be demonstrated. Application of fail soft, fault tolerant concepts which will enable systems to operate despite failures and battle damage and which can gracefully degrade as failures accumulate, rather than fail catastrophically will be demonstrated on advanced Command, Control, Communication, and Intelligence (C^3I) system models.

B. (U) Project: 4519, Communications Technology. This project develops technologies which increase communication data rates, survivability and flexibility. Communication survivability technologies include enduring network techniques, advanced processors, spread spectrum modems, and adaptive nulling techniques. Improved satellite communication (SATCOM) technologies for global communications are developed. Since future C^3I systems will be more distributed for survivability, communication links between distributed elements will assume greater importance. Fiber optics technologies for high payoff applications in Air Force C^3I systems are developed. Although fiber optics technology for land based voice and data communications have matured in the commercial sector, unique Air Force requirements make the fiber optics research and development in this project essential. Air Force applications include: replacement for radio frequency waveguides where volume and weight are tightly constrained; field ruggedized fiber optic based systems; and optical multiplexers and transceivers for high capacity, secure communication systems. Accomplishments in FY 1986 included a demonstration of high speed, externally modulated transmission over fiber cable at 21 Gigahertz; multiwavelength operation over a fiber optic local area network; implementation of a fully qualified, radiation hardened fiber optic connector; and completion of the design for a SATCOM modem for the airborne command post. The basic feasibility of an Acoustic Charge Transport device was established. These devices may revolutionize analog signal processing in terms of speed and accuracy. In FY 1987 demonstration of an optical rotary joint for satellite terminals is planned, as well as the initiation of development of optically implemented radio and radar functions. Work will be initiated on

endurable communication network techniques. In FY 1988 the design of an all-optical, laser-based communication system will be initiated; and development will begin on fiber optic based, extremely high frequency, phased array antennas operating between 20 and 60 Gigahertz. Work on optical computer-based processing will be initiated. In FY 1989 a multi-gigabit, single-mode fiber optic local area network will be demonstrated, and initial optically implemented radio functions will be demonstrated. The Integrated Communication System Simulator will be operational to determine the endurability of communication networks. Work will be initiated on a smart, self-adaptive receiver which will be highly resistant to the total spectrum of countermeasures.

C. (U) Project: 4594, Intelligence Technology. This project develops technologies which improve and automate Air Force capabilities to process and provide useful and timely intelligence information from all sources. Improved data recording and handling techniques are developed for timely processing, storage, and dissemination of extremely high data rate, large volume digital information. Near real-time target classification and multi-sensor correlation techniques are developed to increase the quality and timeliness of intelligence. Data base handling techniques and knowledge based systems are developed to improve the consistency, quality, and speed of intelligence analysis. Advanced cartographic and photogrammetric technologies are developed for extracting three dimensional earth surface data to support en route and terminal guidance of future Air Force weapon systems. In FY 1986 materials were developed to provide a read, write, and erase capability for digital optical disks, vastly improving the utility of this storage medium which was previously a read only medium. An expert system prototype for assessment of foreign space launches was completed. This prototype demonstrates the feasibility and operational utility of using "smart computers" to support the Space Command intelligence analyst responsible for tracking space foreign launch activity. The capabilities of automatic target location technology will transition to advanced development in FY 1987. A multiple sensor technique to enable speech transmission and reception in very noisy environments was developed. Results show an eight to twenty percent improvement over the best noise cancellation microphones in use today for both intelligibility and automatic speech recognition. Plans for FY 1987 include the development of automated techniques for the exploitation of reconnaissance imagery. A cockpit speech enhancer will be developed which will optimize existing speech enhancement algorithms. The algorithms will be tuned separately for human listeners and for computer speech recognition. Efforts will be initiated to develop optical mass storage and retrieval devices which contain no moving parts. FY 1988 will continue development in automated imagery exploitation, target detection, classification, and identification, and the application of advanced technology to counter denial and deception tactics. New efforts include the development of techniques for exploiting airborne visual and infrared spectrometer data for countering denial and deception techniques, and advanced techniques for applying artificial intelligence to automated imagery exploitation. In speech processing, voice synthesis will be extended to include all North Atlantic Treaty Organization languages. Techniques will be developed to allow voice synthesis to support graphic displays used in a battle management information system. In FY 1989 the development of optical memory techniques, and natural language speech recognition techniques will continue. Efforts in knowledge based (expert systems) for intelligence analysis consisting of automated acquisition tools, and knowledge representation techniques for characterizing various threats will be initiated. In addition, a data base/ knowledge base interface will be developed.

D. (U) Project: 4600, Electromagnetic Radiation, Devices and, Components. This project provides a strong nology base in solid state devices and techniques required to utilize millimeter wave, microwave, and infrared (IR) radiation in Command, Control, Communications, and Intelligence (C^3I) systems. Technologies developed include monolithic microwave integrated circuits and phased array antennas to provide more affordable, higher performance radars and communications systems. Electromagnetic propagation and scattering technology developed can determine efficient propagation techniques for communication and surveillance systems using propagation modeling and provide detailed characterization of low observable targets. Components such as short cavity lasers, quantum-well lasers, low loss fibers, and modulators that operate at very high modulation rates are developed for future military fiber optic systems. The military fiber optic systems in Project 4519 (discussed above) use the fiber optic components developed in this project. High purity materials with tailored properties, such as quartz, indium phosphide (InP) and its alloys, and fluoride glasses are developed. Air Force systems require technologies for precision time and frequency devices which depend on the materials developed in this project. Signal processing and sensing devices developed in this project will lead to more capable passive battlefield sensors and space object detection systems with reduced cost of ownership. Research in radiation hardening of devices and components will ensure C^3I mission success in nuclear and space environments. FY 1986 accomplishments include the fabrication of integrated circuits on silicon-on-sapphire wafers having both improved performance and increased radiation hardness. Initial breakthrough in calibrated measurements of the Platinum Silicide (PtSi) focal plane camera were made during boost phase of Minuteman III rocket exhaust plumes. High purity, zero defect single crystals of quartz were grown, and the technology was transitioned to industry. A survivable meteor burst communication demonstration was completed. In FY 1987 the planned program includes continued development of monolithic millimeter wave phased arrays for satellite communications (SATCOM) and multi-frequency reconfigurable arrays for airborne radar. Silicide IR camera focal plane array sizes will be increased to improve target character resolution. An intrusion resistant optical communications link will be extended to single mode fibers and longer wavelengths. Further studies of optical signal processing, pattern recognition and nonlinear optics will be undertaken. Growth of InP single crystals in a magnetic field will be demonstrated with a new facility. Silicon-on-insulator programs will be initiated. The FY 1988 planned program will emphasize optical control of phased arrays and techniques for using optical components for the generation of microwave and millimeter wave energy. Another area of emphasis will be the reduction of the radar cross section of antennas through the use of radomes. A PtSi IR acquisition camera will be completed and installed at the Air Force Maui Optical Station for assessment as a satellite tracking device. Programs in photonics will develop high resolution spatial light modulators, high frequency modulation of semiconductor lasers and integrated optical/electronic-millimeter wave-microwave devices. Improved methods for fabricating dielectrically isolated substrates for radiation hardened electronics will be developed using ion implantation and recrystallization techniques. InP substrates will be demonstrated for thermal stability. Conformal array technology will be developed to support the integration of C^3I capabilities into the aircraft skin. In FY 1989 a full scale array program will be initiated to develop operating arrays at 20 and 44 Gigahertz (GHz) for airborne SATCOM terminals. Initial subarray developments at 60 GHz will be completed. Transition to 6.3 of a low cross section antenna will be made. A two-dimensional high frequency adaptive beam forming array will be evaluated for antijam and clutter mitigation. A long wavelength silicide IR camera will be developed and tested for tactical and strategic sensors. The materials and devices program will include investigations of quantum-well structures for enhanced electro-optic and nonlinear optical components which will provide a higher efficiency rating.

E. Project: 5581, Comand and Control Technology. This project develops technologies which advance Air Force capabilities in Command, Control, Communications and Intelligence (C^3I) by providing strategic and tactical field commanders with improved techniques for the processing and presentation of information for battle management. Technical areas include: Artificial Intelligence (AI) including expert system Command and Control (C^2) decision aids; distributed processing techniques for the implementation of distributed, rather than centralized, C^2 systems for increased survivability; and, finally, technologies and C^2 processes for implementing electronic combat in battle management. C^3I software systems have become very costly due to large size and a high degree of complexity. To reduce software costs and to increase the quality and reliability of software, software engineering research in this project addresses: research on software tools (such as editors, compilers, etc.) for more efficient software development; rapid prototyping of software systems so a user can better specify what he wants before all the software development is done in detail; and procedures for measuring how well software will perform and how easily it can be supported. The AI technology developed in this project supports both the software effort and C^2 decision aids. FY 1986 accomplishments include the identification and classification of all processes and data flow paths within the Tactical Air Control System (TACS) required to plan, direct, and control the integration of Command, Control, and Communications (C^3) Countermeasures in the TACS. A mobile C^2 Technology Laboratory (formerly called the Battle Management Lab) was completed which can be remotely connected to the Rome Air Development Center laboratory and to other ground-based user sites, and can also be deployed for participation in field exercises. Initial work was completed in the development of software reliability prediction techniques. Efforts were also completed for Ada programming techniques. The Ada work will enhance state-of-the-art testing techniques for Ada application software. An effort was initiated to integrate software reliability and testing techniques for improved software reliability assessment. In FY 1987 AI technology will be applied to the development of enhanced simulation capabilities enabling the demonstration and evaluation of advanced C^3I battle management systems and tools. Major emphasis in the C^2 decision aid area will be on the integration of individual aids into a system level configuration (integrated environment). The following will be available: decision aid development support environment; integrated decision aid architecture; and an option generation decision aid. The role of the C^2 Technology Laboratory in support of initiatives such as the Battle Management Information Processing and Display System and Theater Air Warfare C^3 will be further defined. The applicability of state-of-the-art optical processing devices in hybrid (optical/electronic) computers will be determined and the design of optical digital computers will be investigated. Plans call for the continued exploitation of AI technology to improve conventional software engineering tools and methods. Work will be completed on a very high level language prototyping tool which will enhance rapid prototyping of mission critical software systems. In FY 1988 the Knowledge Based Software Assistant support for distributed operating system allocation procedures will be investigated and developed for advanced C^2 systems. Emphasis in the area of survivable C^3 will be on developing distributed system reconstitution techniques using network and distributed data base reconfiguration strategies. Efforts will continue to explore the applicability of state-ofthe-art optical processing devices in hybrid (optical/electronic) computers and to investigate the design of optical digital computers. Knowledge based systems technology will be developed. Technology efforts contributing to the Battle Management Information Processing and Display System thrust will also be developed. Work will be initiated for reusable specification to reduce up front costs in software development. The results will be applied to requirements analysis during the concept definition phase of the software life cycle. During FY 1989 emphasis in the distributed systems area will be on the development and demonstration of control

strategies which support reconfigurability and real-time distributed processing. Software engineering technology for significantly improved software evaluation will be provided by developing a software measurement testbed capability. The results of prior logic programming efforts will be incorporated into a design for a rapid prototyping system based on this technology. Efforts will be completed for combining knowledge based and conventional software engineering tools.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 06RA, Laboratory Operations

A. (U) Project Description: This project provides management and support for Rome Air Development Center (RADC), Griffiss AFB, NY, and two divisions of RADC located at Hanscom AFB, MA. Support provided includes pay and related costs of civilian scientists, engineers, and support personnel; travel; transportation; rents; communications; utility costs; procurement of supplies and equipment; and contractor support services. In addition to the research and development program described above, RADC manages technology intensive engineering development programs, primarily in the intelligence area and provides technical support to system program offices.

B. (U) Program Accomplishments and Future Efforts: Not Applicable.

C. (U) Major Milestones: Not Applicable.

9. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 4506, Surveillance Technology

A. (U) Project Description: This project develops advanced ground, airborne, and space based system concepts and technologies required to accomplish future Air Force surveillance missions. Major development efforts include: technology for new surveillance radars; surveillance technology to counter low observable threats; and counter-countermeasure technologies to defeat electronic warfare threats directed against our surveillance systems. Enabling technologies for space based radar and an advanced airborne surveillance radar (future Airborne Warning and Control System) with capabilities to detect and track high speed, low radar cross section threats in severe jamming environments are based on the signal processing, array antenna techniques and solid state transmit/receive (TR) modules developed in this project. Multistatic radar technologies and advanced concepts to detect and track low observable threats are developed. Signal processing technology is developed employing advanced algorithms and architectures. Solid state TR modules using Monolithic Microwave Integrated Circuits are developed to improve performance and reliability and to reduce size, weight, and cost. Microwave tubes for satellite communication airborne terminals, satellites, ground and airborne radars are improved and developed.

B. (U) Program Accomplishments and Future Efforts:

Program Element: 62702F Title: Command, Control, and Communications
DOD Mission Area: 521 - Electronics and Physical Sciences (ED) Budget Activity: 1 - Technology Base

(1) (U) FY 1986 Accomplishments: FY 1986 accomplishments include the development of a dual-polarized S-band tracking radar system for the Rome Air Development Center Surveillance Lab. This radar will collect target data as a function of various polarizations, wide band waveforms and spectral/temporal processing techniques. The data collected in this radar system is the baseline to future surveillance in radar designs. Also developed was the Phased Array Lens Demonstration Space Based Radar antenna. The program demonstrated that monolithic phase shift modules could be integrated into a lightweight membrane antenna and provide beam pattern control at near prediction levels. In the Monolithic Microwave Integrated Circuits (MMIC) area, a monolithic chip was developed which integrated signal control/conditioning circuits which allows adaptive control of phased array antennas. Radar rule-based data processing techniques were also developed which demonstrated an order of magnitude improvement in target detection. The impact of low observable threats on radar sensors was quantified. Simulated models for low observable threats were validated through reduction of target and clutter data collected from E-3 and ground radar against recent operational cruise missile flights. This data base will provide a baseline for current sensor upgrades and advanced sensor design requirements.

(2) (U) FY 1987 Program: FY 1987 plans include efforts supporting Space Based Radar technologies and include continuation of antenna subarray development for space experiments, the development of high efficiency MMIC Transmit/Receive (TR) modules, and studies and experiments in clutter definition as viewed from space. Testing of a 2x3 foot active phased array employing solid state TR modules will be done. Beamforming alternatives, radar control techniques, processing techniques, and dual-band TR modules will be developed for the advanced airborne surveillance radar. Surveillance signal processing technology efforts will include high speed systolic processors. In the area of MMIC module development, power conditioning, chip yield improvement, and chip level integration of analog to digital conversion for digital beam forming will be developed. Efficient, low cost traveling wave tubes for millimeter wave space communications will be fabricated and tested.

(3) (U) FY 1988 Planned Program and Basis For FY 1988 RDT&E Request: FY 1988 plans include efforts supporting Space Based Radar technology research where an experiment is planned for the evaluation of distributed sensor concepts. This will demonstrate the beam steering/performance capabilities and coherence of a distributed sensor system in a space-like environment. Electronic counter-countermeasure techniques will be developed to defeat future smart jammers using spatial or temporal rejection or by exploiting jammer characteristics. Advanced beamforming integrated with TR modules under digital processor control will be developed for use on an airborne radar demonstration. Radar experiments and methods to effectively combine information from airborne sensors will be developed. To meet the surveillance requirements of low observable threats in a dense jamming/clutter environment, advanced signal processing techniques such as multi-domain (time, frequency, polarization, spatial, etc.) processing algorithms will be evaluated in conjunction with advanced information processing techniques including knowledge based tracking. In addition to these processing techniques, advanced TR module circuits will be developed to improve detection capabilities in a dense jammer/clutter environment. Efforts to integrate scanning arrays, sensors, monolithic circuits, and controls into external surfaces of aircraft and missiles will be initiated to support the initiative to integrate C^3I functions into the skin of an aircraft (i.e., "Smart Skins").

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Methods to detect threats with reduced

radar cross sections (stealth) and to survive increased enemy electronic warfare capabilities will be developed to successfully accomplish future Air Force surveillance missions. Emphasis will be placed on the development of multi-spectral sensors to counter both the low observable as well as electronic warfare threat. The sensors will be developed for use with either ground based, airborne, or space based systems. The technology base requires the development of multiband passive and active sensors which can provide both long range target detection and sufficient target resolution to allow hand off/engagement to a weapon system. Integral to this process will be the development of methods of identification using both individual sensor high resolution methods, such as high resolution ranging and integrated multi-source sensor methods. Advanced high throughput processors using Very High Speed Integrated Circuit submicron and Gallium Arsenide devices will be developed. The objectives of initiatives on Smart Skins, Multi-Static Radar, and Distributed Sparse Array of Spacecraft will be emphasized.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not Applicable

10. (U) COOPERATIVE AGREEMENTS: Not Applicable

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63106F
DOD Mission Area: 553 - Engineering Technology (ATD)

Title: Logistics Systems Technology
Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	8,852	10,740	12,747	19,645	Continuing	N/A
2744	Unified Data Base for Acquisition Logistics	1,796	*	*	*	*	*
2745	Logistics for Combat Readiness Maintenance	725	655	75	75	Continuing	N/A
2940	Computer Technology for Systems Design and Maintenance	4,676	7,142	6,025	11,547	Continuing	N/A
2950	Integrated Maintenance Information System	1,084	2,943	6,647	8,023	Continuing	N/A
3203	Integrated Maintenance Information System Diagnostic Tests	571	**	**	**	**	**

* Work and funding for Project 2744 were integrated into Project 2940 of this PE in FY 1987.
** Work and funding for Project 3203 were integrated into Project 2950 of this PE in FY 1987.

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Air Force needs to improve the maintainability, combat supportability and reliability of Air Force weapon systems. DOD Defense Guidance, OSD funding initiatives, and the R&M 2000 Action Plan, endorsed by the Air Force Secretary and Chief of Staff, have emphasized this need. The Logistics Systems Technology Program develops, demonstrates, and validates information system technologies that will: (a) enable individual technicians to do a much wider range of maintenance tasks with the help of highly portable electronic job aids; (b) allow weapon system designers to "see" maintenance implications as they create system designs on computer terminals; (c) make essential weapon system design and system support information immediately available from multi-computer information networks; (d) rapidly determine the best balance of conflicting logistics, manufacturing, and performance requirements to design more sustainable and mission suitable weapon systems; and (e) integrate combat experience into wartime logistics planning and capability assessment models.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	8,952	19,061	29,069	N/A	Continuing	N/A

EXPLANATION: (U) Differences are due to a Congressional reduction of funds in FY 1987. FY 1988 reductions accommodate reduced Air Force Total Obligation Authority.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: Continuing and close coordination among the Army, Navy, Air Force, other Department of Defense, National Aeronautics and Space Administration (NASA) and industrial organizations is done to eliminate redundancy in logistics research and development. Projects are coordinated with: NASA's Integrated Program for Aerospace Design and with Department of Defense Manufacturing Technology Advisory Group through membership on their Computer Aided Design/Computer Aided Manufacturing (CAD/CAM) subcommittee; the Joint Logistics Commanders' Joint Policy Coordinating Group for Logistics Research, Development, Test & Evaluation subpanels for Automated Technical Information, and Reliability and Maintainability in Computer Aided Design; and The National Security Industrial Association, Logistics Management Committee, CAD Working Group. CAD efforts are also coordinated with the Integrated Computer Aided Manufacturing Program of PE 78011F. Technology to implement the DOD Computer-Aided Logistics Support (CALS) initiative is closely coordinated with all aspects of the CALS effort, including PE 63736D Computer Aided Logistics Support. Technology input to PE 63106 comes from related program elements: 62201F, Aerospace Flight Dynamics; 62205F, Training and Simulation Technology; 62702F, Command, Control, and Communications; 63253F, Advanced Integration Avionics; and 63751F, Training Systems Technology. Technology outputs are provided to 64740F, Computer Resource Management Technology; 78011F, Manufacturing Technology; 63742A, Advanced Electronic Devices and others.

6. (U) WORK PERFORMED BY: This program element is managed by the Air Force Human Resources Laboratory, Brooks AFB, TX, through their Logistics and Human Factors Division, Wright-Patterson AFB, OH, with direct support from the Air Force's Flight Dynamics Laboratory, Wright-Patterson AFB, OH. Many development tasks require multi-laboratory efforts with specific laboratory involvements varying from one year to the next. Primary contractors doing work funded by PE 63106F include: Rockwell International, Los Angeles, CA; Systems and Applied Sciences Corporation, Vienna, VA; Boeing Aerospace Company, Huntsville, AL; and General Dynamics Corporation, Ft Worth, TX. There are five additional contractors doing work with a combined dollar value of $5 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 2745, Logistics for Combat Readiness Maintenance. The Air Force needs to accurately predict how many people and parts must be provided when tactical aircraft are deployed in wartime conditions. At present there are no satisfactory analytical tools or procedures to determine the changes in demand for aircraft maintenance from peacetime to wartime. Aircraft battle damage and intense operational use of weapons delivery systems and electronic warfare systems create wartime demands for skills and levels of maintenance activity which are not seen in peacetime. Studies of wartime data from recent conflicts show that extrapolation from peacetime experience does not give realistic results. This project develops data bases derived from combat experience and analytical methods that will generate valid inputs for predictive models to accurately determine resources needed under wartime conditions. Factors that drive demands for maintenance in combat are being identified through analysis of actual wartime data. During FY 1986, work began on predictive models whose capabilities will be evaluated in FY 1987 against historical combat logistics data. The project will also develop recommendations for realignment of maintenance career fields. This realignment, made possible by new maintenance aids to be developed under Project 2950, Integrated Maintenance Information System, will permit fewer, less-specialized technicians to support dispersed, high surge operations in combat. In FY 1988, work

will begin to develop combat capability assessment and readiness planning methodologies which will address the benefits of new maintenance aids and the impact of the realignment of maintenance career fields. The methodologies will include new requirement prediction techniques, and methods for determining small unit manning requirements. In FY 1989, this project will test these new methodologies in the field at the small unit level. Also, work will begin to develop decision aids to provide Wing level staffs with logistics information vital to successful wartime operations.

B. (U) Project: 2950, Integrated Maintenance Information System (IMIS). IMIS will be a complete system for providing the maintenance technician on the flight line with automated maintenance instructions and fault diagnostic aids through a single, portable computer display. The user-friendly, stand-alone IMIS portable computer will allow maintenance technicians to work interactively with built-in test capabilities of the weapon system. IMIS's rapid automatic interrogation of supply status and automatic reporting with artificially intelligent analysis will allow managers to quickly pinpoint deficiencies in supply or maintenance procedures or training. When fully developed for field use, the IMIS terminal and software will permit fewer people to perform a wider range of maintenance tasks in the deployed tactical environment of the future. Products of this effort will include specifications, Tri-Service coordinated standards, and automatic authoring systems which will aid in preparing maintenance and diagnostic instructions for electronic screen display. In FY 1986, field tested specifications for the electronic display of maintenance information were delivered. In FY 1987, a relational authoring approach is being tested. It creates electronic technical orders in the form of relational data bases which require less computer storage space than fixed pages and which allow screen displays to be tailored to the skill of the individual technician. This authoring approach will form the basis of the Army Job Performance Aid Production System (JPAPS) and become the standard for Tri-Service use. Also during FY 1987, extensive diagnostic analysis and generic diagnostic system design will be accomplished for mechanical-pneudraulic and electronic subsystems using flight data from advanced designs such as X-29 experimental fighter. In FY 1988, software will be developed for the IMIS portable maintenance aid to be field tested in FY 1989 with the interactive diagnostics on an F-16 electronic subsystem. A joint test with the Navy on an F-18 non-electronic subsystem is also planned. The requested increase in FY 1988 funding over FY 1987 is necessary to translate the weapon system data from paper technical orders into digital form for these crucial proof-of-concept field tests. Also in FY 1988, a major development contract will be awarded for an advanced voice-controllable miniaturized IMIS maintenance aid. This advanced IMIS will include a supply and reporting interface, simulation capability for training in the field, and full system integration of diagnostics for Very High Speed Integrated Circuits (VHSIC) and modular electronics architectures. This increased diagnostics capability will permit the maintenance technician to readily assess the condition of modern, modular, fault tolerant, reprogrammable, redundant electronic circuitry. Thus, the technician will be able to determine whether a partially degraded system can continue to support combat missions without downtime for repairs. Development and evaluation of technologies, such as display screens with low power requirements and voice recognition, applicable to rugged, portable, computerized maintenance aids will continue. The FY 1989 program will continue the development of IMIS technology as well as the demonstration on an F-16 test bed. Software, interface, and detailed design documentation will be prepared. Detailed technical reviews will be conducted to prepare for future validation and demonstration of system specifications and standards being developed under this project. Initial IMIS results will transition in FY 1989 to be available for use on the Advanced Tactical Fighter (ATF). Field demonstrations of the hardware, software, system architecture, and equipment interfaces will culminate with transition into the VHSIC and advanced modular architecture insertion programs in the early 1990s, and will become the standard for the Air Force

Advanced Technical Order System (ATOS). ATOS, together with the Integrated Maintenance Information System, will permit rapid electronic updates of weapon system technical orders, thus eliminating time-consuming manual posting of technical order changes.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2940, Computer Technology for Systems Design and Maintenance

A. (U) Project Description: Reliability, maintainability, and testability are characteristics which must be designed from the start into Air Force systems. The goal of this project is to develop, demonstrate, validate, and specify computer technology to improve weapon system design and supportability. The project consists of three parallel, interrelated tasks: (1) developing the capability to apply decision aids, including expert systems to design for supportability, (2) developing the capability to electronically access all weapon systems engineering data throughout the life time of the weapon, and (3) developing and testing an automated, interactive data base for logistics support analysis data. These tasks will result in consistent specifications and standards needed for rapid electronic interchange of technical information. The first task, Maintenance and Logistics in Computer-Aided Design (MLCAD), will develop computer-aided design methods to enable contractors to more effectively incorporate reliability, maintainability and testability into weapon systems designs from the outset. This will reduce expensive and time-consuming redesigns and modifications, and will produce far more supportable and operationally ready weapon systems. This task will also develop decision aids, in support of the Air Force's Unified Life Cycle Engineering (ULCE) initiative, which will allow designers and logisticians to evaluate tradeoffs and allocate requirements in a consistent information architecture analysis structure, throughout the total design and acquisition process. ULCE will include user-friendly decision aids necessary to integrate relevant performance, supportability, and producibility factors to rapidly consider and wisely choose among system design alternatives. The second task, Integrated Design Support System, will provide specifications, standards, and software to enable the Air Force to electronically access contractors' weapon system technical information data bases, and to facilitate exchange of technical information between prime contractors, subcontractors and the Air Force. Industry has moved rapidly into computer-aided design systems, yet the Air Force cannot communicate directly with these data systems to review and evaluate weapon system designs. Neither can the Air Force currently save this valuable data, except on paper or microfilm, for subsequent logistics, maintenance, remanufacturing or engineering needs. This project defines the specific engineering data base required by the Air Force and develops the software architecture required for interactive communication of digitized engineering data. This task will provide research and development support for the automation and integration of digital product definition information. The third task, the Unified Data Base (UDB), will, for the first time, allow the replacement of the current, manual, paper-based system for logistics support analysis data with automated electronic data processing capability. The UDB will provide current logistics planning data and accurate field operational experience on weapon system performance to both the government and contractor engineers.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: A Government-University-Industry MLCAD cooperative working group was established with the Institute for Defense Analysis as administrator. A critical technical milestone of the Integrated Design Support (IDS) system was successfully accomplished with the demonstration of rapid access, through a single terminal and information control system, of all the essential engineering data bases for a major structural repair and modification. The primary contractor, Rockwell International, and a government-industry advisory group identified the key requirements and elements of an Integrated Design Support (IDS)-type system. The development of Unified Data Base (UDB) software was completed.

(2) (U) FY 1987 Program: New Maintenance and Logistics in Computer-Aided Design (MLCAD) techniques are being developed and tested through their application to F-15E support equipment and procedures for munitions loading within the cramped space constraints of a hardened aircraft shelter. A major contract will be awarded for integrating various electronic reliability design techniques into a single model, to be accessed through a computer aided electronic design work station. The IDS program will begin a major technical advance to integrate multiple types of computers using B-1B aircraft structural component data as a test case. The UDB will complete validation, verification, and documentation, and will enter certification for DOD-wide use.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: MLCAD development will continue the development of a generic artificial intelligence format for integrating new supportability techniques into the electronic design work station. MLCAD will be expanded to include a computerized anthropometric model incorporating size, strength, and mobility of Air Force maintenance technicians. Use of this model, developed jointly under program elements 62205F, Training and Simulation Technology, and 62202F, Aerospace Biotechnology, will provide visual simulation of maintenance and component access problems directly to system designers on their CAD terminals. Additional MLCAD enhancement will begin to allow designers to compare the time required for maintenance tasks on alternative weapon system designs. Thus given the ability to consider accessibility and related human factors during initial design tradeoffs, engineers will be able to design weapon systems that people can quickly and easily maintain in the field. Draft specifications and processes for incorporating MLCAD into contract requirements and using it to conduct design reviews will also be developed. This project provides the nucleus for the long-term multi-laboratory work in integrating design, logistics, support, and producibility disciplines into the computer-aided design Unified Life Cycle Engineering concept. The IDS task will continue design and development efforts in preparation for demonstrations and testing.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Development will begin on a prototype Unified Life Cycle Engineering work station along with the necessary models and software to integrate MLCAD and producibility models with standard performance engineering analyses. Further MLCAD enhancements will be developed to incorporate new knowledge about the effects of operating conditions, such as temperature, humidity, electro-magnetic pulse, and vibration on components and their interconnections in various configurations. Testing, verification, and validation of prototype MLCAD software will be the basis for the specification and standards development for use Air Force-wide. These enhancements will allow engineers to design systems right, for reliability, the first time. IDS will

begin the prototype demonstration of the capability to integrate all the necessary data for structural design and logistics planning through distributed information networks comprised of many already installed computers of different design and manufacture.

(5) (U) Program to Completion: This is a continuing program. Work continuing past FY 1989 emphasizes design, development and testing of the Integrated Design Support (IDS) prototype software and Maintenance and Logistics in Computer-Aided Design techniques. The IDS results will provide the Air Force the capability to access digital contractor engineering data bases and to transfer data between design, manufacturing and logistics functions. These integration efforts will be completed in FY 1992. Demonstrations of Unified Life Cycle Engineering technology will continue through FY 1994.

C. (U) Major Milestones: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: The Israeli Air Force (IAF) has agreed to provide classified combat logistics data on several aircraft to the US Air Force Human Resources Laboratory (AFHRL) for development of a combat data base and analysis system.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63109F Title: INEWS/ICNIA
DOD Mission Area: 551 - Electronic and Physical Sciences(ATD) Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		46,349	103,227	83,300	40,958	Continuing	N/A
2273	Integrated Electronic Warfare System (INEWS)	5,600	32,118	30,246	14,121	N/A	N/A
2538	Integrated Communication-Navigation-Identification Avionics (ICNIA)	19,457	28,900	15,000	11,100	Continuing	N/A
2734	VHSIC-Based Subsystems	11,666	30,652	21,900	4,000	N/A	N/A
2735	Integrated Flight Demonstrator	800	Transferred to PE 63253F				
3003	INEWS/ICNIA Modular Avionics System Architecture	3,000	2,904	3,000	937	Continuing	N/A
3062	Pave Sprinter	5,226	5,253	10,654	7,300	Continuing	N/A
3393	ICNIA Pre-FSD	600	3,400	2,500	3,500	0	18,600

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Current avionics systems are major contributors to inadequate weapon system reliability and represent a substantial and increasing fraction of aircraft acquisition and support costs. The INEWS/ICNIA program will exploit a number of recent innovations in systems architecture, semi-conductor technology, computerization and computer software to integrate and automate avionics functions for current and advanced aircraft. This program will concentrate on the defensive electronic warfare and communications, navigation, identification avionics systems and the architecture technologies necessary to tie them together. Objectives include operational performance improvements, very high mission reliability, fault tolerance, substantial reductions in both acquisition and support costs and reduction of crew workload in dense threat environments. To satisfy these objectives major thrusts are currently underway for early insertion of Very High Speed Integrated Circuits processors in both core avionics and selected subsystems. Additionally, an intense effort will be pursued to develop standard modular packaging techniques and to flight test developed hardware on tactical aircraft. These efforts will greatly reduce size and weight, increase reliability and substantially lower overall operation and support costs.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
RDT&E	43,853	60,107	31,954	N/A	Continuing	N/A

EXPLANATION: (U) The FY 1986 increase was due to a reprogramming action as encouraged in the FY 1986 Authorization Act. The FY 1987 increase was provided by Congress in the Appropriations Bill for Advanced Tactical Fighter (ATF) related development and a subsequent Air Force reprogramming. The increases in FY 1988 and 1989 reflect an increased pace of progress and additional effort to integrate ICNIA and INEWS as directed by the Congress, and ready the technology for transition into the ATF Program for full scale development, and the transfer of core INEWS Funds from the Navy PE (63109N).

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: PE 62204F, Project 2003, Avionics System Design Technology, Project 6095, Inertial Reference and Guidance, Project 7662, Avionics Data Transmission and Reception and PE 63203F, Project 2733, Advanced Reconnaissance Strike Radar will provide supporting technology for this program. PE 63226F, DOD Common Programming Language (Ada) Advanced Development and PE 63728F, Advanced Computer Technology will provide Ada support software products for use by this program for application to avionics related software developments. Close coordination with the Defense Advanced Research Projects Agency (DARPA) sponsored Pilot's Associate Program is needed so that expert systems technology can be used to reduce crew workload. Technical interchange between this program and PE 63601F, Project 670A, Ordnance Technology, will be maintained to insure successful implementation of MIL-STD-1760 Aircraft-to-Stores Interface. Detailed dialogue with PE 63231F, Project 2829, Cockpit Automation Technology will be maintained to insure appropriate use of new automation, control, and display concepts. Several items of work being accomplished under PE 62204F, Project 2003, have been partially funded by the former PE 63253F Advanced System Avionics and have been transitioned into the Integrated Electronic Warfare System (INEWS)/ICNIA integrated avionics architecture baseline. These efforts are: Airborne Electronic Terrain Map System, a Multi-bus Avionics Architecture Design Study, and a Video Information Distribution System Study. The INEWS/ICNIA Integrated Avionics Architecture (IAA) project will use hardware developed under PE 63452F, Project 2700, Very High Speed Integrated Circuits (VHSIC) as well as VHSIC insertion funding in developing the VHSIC 1750A processor and the VHSIC Common Signal Processor (CSP) required in the integrated avionics architecture baseline. The Advanced Tactical Fighter under PE 63230F will be a prime potential user of these new technologies.

6. (U) WORK PERFORMED BY: Current efforts are being performed by Rockwell International, Collins Avionics Division, Cedar Rapids, IA (ICNIA); International Telephone and Telegraph Avionics Division, Nutley, NJ (ICNIA); TRW, Incorporated, San Diego, CA (ICNIA), INEWS and VHSIC 1750A); International Business Machines, Manassas, VA (CSP); Texas Instruments, Dallas, TX (ICNIA); Sanders Associates, Nashua, NH (INEWS); General Electric Co, Utica, NY (INEWS); and Westinghouse Electric Corporation, Harmons, MA (VHSIC 1750A and INEWS). The in-house organization responsible for

the program is the Aeronautical Systems Division, Wright-Patterson Air Force Base, OH.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 3003, INEWS/ICNIA Modular Avionics System Architecture (MASA). The independent design and development of avionics subsystems on modern aircraft has resulted in a proliferation of hardware subsystems. These subsystems can be difficult to maintain, require unique and complex test equipment, require a huge number of different spares, and cannot share resources, resulting in single point failures. As we carry out the will of the Congress in merging these two programs into a concerted integrated avionics development effort, this project forms the cornerstone of our plan to design, develop, and implement standard line replaceable avionics modules and supporting integrated diagnostics, initially for the Integrated Electronic Warfare System/Integrated Communications, Navigation Identification Avionics (INEWS/ICNIA) system, and eventually all avionics systems, which will be compatible with the architecture specified by the Advanced System Avionics definition contracts conducted in project 2734, PE 63253F. In addition to functional performance, the following evaluation criteria will be utilized for proof of concept: reliability, environmental performance, cost effectiveness, testability, adaptability to optimal on/off equipment maintenance, and module commonality. The effort will design and develop candidate avionics modules not developed under other projects, and integrated enclosures for these modules, addressing the problems of interconnections, rack mounting, power and cooling requirements. The FY 1986 program continued development of modular avionic standards, defining the module set, and the development of the technologies required for modularization, e.g., Very High Speed Integrated Circuit (VHSIC) common data and signal processors and high speed data bus. Initiated development of candidate avionics modules and the required enclosure, interconnections, rack mounting and cooling. Initiated development of advanced integrated diagnostics and fault tolerant techniques. Continued the application of the modular concepts to the integrated communications, navigation, identification functions and applied these concepts to design a fault tolerant integrated reference system. The FY 1987 program will continue development of candidate avionic modules and the required enclosure, interconnections, rack mounting, power and cooling requirements. Continue development of advanced integrated diagnostic and fault tolerant techniques. Complete preliminary performance assessment of these techniques using modular VHSIC data and signal processors as test articles. Continue development of the VHSIC data and signal processors and high speed fiber optic bus. The FY 1988 program will continue the application of these modular concepts to the integrated CNI system and to the fault tolerant integrated inertial reference system. Modular avionics standards for application across the spectrum of avionics systems will be developed. The FY 1989 program completes the initial standards development. The FY 1990 and beyond program designs and fabricates the initial set of standard line replaceable modules for insertion into new system developments. Funding requirements are based upon the cost of contracts for similar technology efforts and are category II.

B. (U) Project: 3393, ICNIA Pre-FSD. This project, which began in FY 1986, is designed to transition the advanced technology integrated avionics being developed in Project 2538, ICNIA, into full scale development (FSD) for the Advanced Tactical Fighter (ATF) and other aircraft. In FY 1986 the project initiated cost-benefit studies of the signal mix needs of various current and future aircraft to determine the subsets of ICNIA capabilities to be included in FSD versions tailored for each type aircraft from the overall set of hardware line replaceable modules resulting from the ATF FSD effort. These studies will continue in FY 1987 and preparation of FSD specifications

and statements of work (SOW) will begin. The planned FY 1988 effort completes the specification and SOW preparation so that requests for proposals may be awarded. The planned FY 1989 effort, which completes the pre-full scale development (FSD) work, will analyze the results of the Advanced Tactical Fighter (ATF) Integrated Communications, Navigation, Identification Avionics (ICNIA) development initiation and prepare specifications and SOWs for development of ICNIA versions for other aircraft from the ATF-developed hardware and software modules to insure interoperability and commonality across many aircraft types of all three services. Funding estimates are based on the costs of similar efforts and are Category II.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2273, Integrated Electronic Warfare System (INEWS)

A. (U) Project Description: INEWS is an Air Force led, joint AF/Navy program to develop the next generation airborne self-protection countermeasures system for advanced technology aircraft, to include the Air Force Advanced Tactical Fighter and the Navy Advanced Tactical Aircraft. INEWS is the defensive system, inseparable from the protected weapon system, which will enable host aircraft to perform combat missions while operating in the technologically advanced multi-static/spectral, netted threat environment of the 1990s. This threat consists of airborne and surface based radar, electro-optical, infrared, and laser directed defense systems and the tactical command, control, communications network which links them together. The advanced threat complicates the INEWS requirement to provide aircrews timely and accurate threat warning with automatic application of optimum countermeasures. The INEWS response will be tailored to the specific mission requirement and threat environment in, at least, near real-time. Effective implementation of INEWS necessitates a defensive capability fully integrated with other aircraft sensors and avionics through an integrated avionics architecture (project 2734) to achieve total weapon system synergism.

B. (U) Program Accomplisiments and Future Efforts:

(1) (U) FY 1986 Accomplishments: The program continued Phase IA Concept Definition Investigation to completion which includes down selection from five to two contractor teams, and initiated the Demonstration/Validation phase preliminary FSD. Specific tasks for FY 1986 included definition of individual, high risk elements (sensors, transmitters, computers, etc.) through emulation, modelling and analysis; validation of overall system concepts and concept tradeoff analysis to refine the INEWS system based on updated threat information and aircraft design characteristics and mission scenario projections.

(2) (U) FY 1987 Program: INEWS Phase IB, Demonstration/Validation preliminary FSD, continues in FY 1987 to insure that the INEWS program executes on schedule so that an effective, affordable self-protection capability is developed in concert with the development of the Advanced Tactical Fighter, Advanced Tactical Aircraft and other advanced technology aircraft. Specific tasks for FY 1987 include starting demonstrations of individual high risk INEWS elements through developing and refining laboratory hardware, identification of performance, integration,

packaging and installation risks, and projection of installed equipment performance. Reliability/maintainability/producability/efforts through computer aided design/computer assisted manufacturing technology application will be initiated. Concept definition, refinement, and concept tradeoff analysis will continue. An effort will commence to develop an Integrated Electronic Warfare System (INEWS) variation of the common signal processor. Program costing for these risk reduction and system design refinement tasks was reviewed in September 1984.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: In FY 1988 the planned program continues preliminary full scale development (FSD) to demonstrate critical subsystem technologies, validates each of the two competing concepts, and completes with down selection from two teams to one contractor team in FY 1989.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The program completes DEM/VAL and transitions to FSD in PE 64250F. Actual FSD and sustaining engineering to meet specific platform requirements begins in FY 1989 and lasts through FY 1992, including flight testing. A timely INEWS production decision will be made in order to marry INEWS with the Advanced Tactical Fighter and Advanced Tactical Aircraft production lines.

(5) (U) Program to Completion: Not Applicable.

C. (U) Major Milestones:

Milestones	Dates
(1) Concept Definition Phase Begun	July 1984
(2) DEM/VAL Phase Contract Award	June 1986
(3) Air Force Systems Acquisition Review Council Milestone I Review	March 1987
(4) Joint Resources Management Board Milestone I review	April 1987
(5) System Design Reviews	April 1988
(6) Transition into Full Scale Development	January 1989

9. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2538, Integrated Communications Navigation Identification Avionics (ICNIA).

A. (U) Project Description: Joint Air Force/Navy/Army project to design, fabricate and test technological approaches to an integrated radio frequency subsystem for aircraft. The technology being developed draws upon the VHSIC technology, applied to RF and digital systems. Payoff will be in reduced size, weight, and software changes. Technological feasibility will be established by early FY 1988. This project will proceed with integration of the Very High Speed Integrated Circuit (VHSIC) 1750A common data processor, and, if feasibile in the latter stages with the functional integration of the common signal processor. Flight testing will be completed in FY 1990 for the ICNIA advanced development model. In conjunction with the National Security Agency develop an integrated Communications

Security/Transmission Security (COMSEC/TRANSEC) module and integrate it into the Integrated Communications, Navigation, Identification Avionics (ICNIA).

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: In FY 1986 TRW and ITT/TI continued development and began fabrication of their respective ICNIA terminals. Integrated Electromagnetic Spectrum Simulator (IESS) fabrication started. The Rome Air Development Center contract for an ICNIA high frequency high power amplifier/antenna coupler was awarded.

(2) (U) FY 1987 Program: Software codeing will be completed, brassboard testing will commence, and ICNIA terminal integration and testing will be accomplished. Funds from Project 3003 and PE 63452F, Very High Speed Integrated Circuits are provided to enable integration and testing of the Pave Sprinter terminal to be initiated.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The FY 1988 program includes final fabrication and testing of the various ICNIA terminals. Terminal deliveries will start in December 1987. An ICNIA terminal will be integrated into the IESS and development of advanced high anti-jam voice and data communications waveforms and their associated ICNIA radio function software modules will begin. Begin fabrication of an Advanced Technology ICNIA (ATI) terminal incorporating VHSIC Phase 2 (0.5 micron feature size) and monolithic microwave integrated circuits (MMIC). Translation of the ICNIA software modules into the Ada language will commence. Funding requirements are based upon the cost of contracts for similar technology efforts and are category II.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Testing of the ICNIA terminals in the IESS will continue, and research into new high anti-jam voice radio waveforms will continue at a higher pace. Development and fabrication of the ATI terminal will continue as will the translation of the ICNIA software modules into the Ada language. Funding estimates are based on planning estimates and are Category IV.

(5) (U) Program to Completion: This is a continuing program. Fabrication of the ATI terminal and translation of the ICNIA software modules into Ada will be completed. The ATI terminals will be tested in the IESS and in representitive test bed aircraft. Development and testing of advanced anti-jam voice radio waveforms will continue, using ICNIA hardware and new Ada radio function software modules to stay ahead of the evolving Soviet Radio Electromagnetic Combat threat.

C. (U) Major Milestones:

Milestones	Dates
(1) Advanced Development Contract Awards	October 1983
(2) Critical Design Review (CDR)	June 1985
(3) Software CDR	March 1986

(4) First Advanced Development Model (ADM) Terminal Delivery	December 1987
(5) Advanced Technology ICNIA (ATI) Development Start	October 1987
(6) ATI Critical Design Review	October 1988
(7) First ATI Terminal Delivery	October 1990

10. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2734, VHSIC-Based Subsystems

A. (U) Project Description: This effort develops advanced fault tolerant avionics system architecture concepts required to integrate and demonstrate key avionic technologies for future strategic and tactical aircraft. Project makes major advances in such diverse areas as common modules, modular integration, optimal on/off equipment maintenance implementation, information fusion, integraced software concepts, artificial intelligence and expert systems. Emphasis is placed on development and validation of high risk technology into a cohesive integrated avionics system supporting significant improvements in availability, cost of ownership, and mission effectiveness for future weapons systems.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Continued the design and development of avionics technologies required for fault tolerant architecture. These technologies include Very High Speed Integrated Circuit (VHSIC) 1750A computer and common signal processor, and the high speed data bus. Worked toward an industry and government consensus on standardization parameters for avionics line replaceable modules (LRMs).

(2) (U) FY 1987 Program: Continue development of those elements required to support the design of a fault tolerant architecture. Emphasis is on serial high speed data bus, VHSIC 1750A data and common signal processors, VHSIC power supply, cockpit automation devices, advanced algorithm development and the integration of avionics hardware subsystems as is being done with communications, navigation and identification subsystems. The two VHSIC 1750 contractors designs will be made interchangeable at the LRM level. Work will continue on validation of high risk technologies. These efforts support the Advanced Tactical Fighter (ATF) Systems Requirements Review effort.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The program will continue development of fault tolerant serial high speed data bus, VHSIC 1750A data and common signal processors, cockpit automation devices, and advanced algorithm development. Further studies and validations will investigate the integrated common architecture in support of the ATF Systems Design Review. The program will also upgrade the real-time simulation facility software. Funding requirements are based upon the cost of contracts for similar technology efforts and are category II.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The common signal processor and VHSIC 1750A data processors will be completed and delivered for testing. After testing the common signal processor will be incorporated into the Ultra Reliable Radar being developed in PE 63203F, Advanced Avionics for Aerospace Vehicles.

(5) (U) Program to Completion: The Very High Speed Integrated Circuit (VHSIC) 1750 A data processors testing will conclude and the advanced development models delivered to other programs for incorporation into new systems under development.

C. (U) MAJOR MILESTONES:

Milestones	Dates
(1) Start Common Signal Processor (CSP) Development	November 1984
(2) Start VHSIC 1750A Development	March 1985
(3) Deliver VHSIC 1750A Data Processors	November 1987 - September 1988
(4) Transition CSP into Ultra Reliable Radar	May 1988

II. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3062, Pave Sprinter.

A. (U) Project Description: This project will flight demonstrate, on an F-16 and possibly an F-15 aircraft, a limited physical implementation of the Modular Avionics System Architecture (MASA) developed in project 3003. The primary emphasis of the project is to show the benefits of VHSIC technology for upgrades of these aircraft. The modular concepts will be first demonstrated by the development of a Pave Sprinter Integrated Communication Navigation, Identification Avionics (ICNIA) terminal. In addition to proving the VHSIC-based modular architecture Pave Sprinter will demonstrate optimal on-equipment maintenance capability with the intent of reducing the dependence upon expensive intermediate maintenance support equipment. The Pave Sprinter ICNIA, fault tolerant inertial reference system, and the fiber optics high speed data bus will be flight demonstrated on an F-16. Candidate systems for demonstration on the F-15 (and possibly the F-111) will be selected and designed, fabricated and flight tested.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: The Pave Sprinter system integration effort was initiated which will intergrate and demonstrate the key concepts of common modules and resource sharing, especially as applied to current aircraft.

(2) (U) FY 1987 Program: Continue development of the Pave Sprinter ICNIA terminals and prepare for the flight test of the basic Pave Sprinter Integrated Communications, Navigation, Identification Avionics (ICNIA) on and F-16. This will include the integration of the fiber optic high speed data bus, Pave Sprinter ICNIA and the fault tolerant inertial reference system.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The FY 1988 planned program will begin integration of individual systems into the flight test fighter aircraft and detailed test planning. Aircraft modifications to integrate the ICNIA, Integrated Inertial Reference Assembly, and High Speed Data Bus for flight testing will begin. Initiate flight tests to prove concepts of resource shareing and fault tolerance through dynamic reconfiguration in flight upon failure. Funding estimates are based upon similar efforts and are category IV.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Flight testing of the ICNIA, Integrated Inertial Reference Assembly (IIRA) and High Speed Data Bus will continue. As the Advanced Tactical Fighter (ATF) design evolves, the ATF avionics architecture will be evaluated and critical subsystems tested in the Pave Sprinter flight test series. Test results will be analyzed and the results fed back into the ATF design process.

(5) (U) Program to Completion: This is a continuing program. Flight testing critical subsystems under development will continue throughout the ATF prototype program and key avionics technologies which can only be tested in flight will be tested in this project as a suplement to, and in conjunction with, the ATF ground-based avionics simulator.

C. (U) Major Milestones:

Milestones	Dates
(1) Aircraft Modifications Begin	May 1988
(2) Flight Tests Begin	July 1988
(3) ATF Critical Subsystem testing	1989 - 1992

12. (U) COOPERATIVE AGREEMENTS: Not Applicable

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63202F
DOD Mission Area: 553 - Engineering Technology (ATD)

Title: Aircraft Propulsion Subsystem Integration (APSI)
Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		27,833	26,137	23,646	27,825	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Science and Technology program provides for the design, development, test and and assessment of advanced air breathing propulsion system technologies applicable to a broad range of subsonic, transonic/supersonic, and high Mach aircraft. It builds upon the core technologies developed under the Advanced Turbine Engine Gas Generator program. The sequential process from component development through generic engine testing is essential to demonstrate availability of new technologies. The scope of the program includes work on: (1) advanced inlet, fan, power turbine, engine control and nozzle components; (2) integrated testing of these components with advanced gas generators (i.e., Joint Technology Demonstrator engine); (3) Expendable Turbine Engine Concept demonstrators for missile applications; (4) definition of engine inlet/exhaust system installation design criteria and propulsion integration technologies; (5) engine structural design criteria through hardware fabrication and test; and (6) improved engine survivability characteristics. These efforts must be performed to permit low-risk transition of advanced technology to engineering development and provide a needed basis for further advances in relevant component technology and integration techniques. This program will provide aircraft systems with a potential for longer range, higher cruise speed with lower specific fuel consumption, surge power for successful engagements, high sortie rates with reduced maintenance, reduced life cycle cost and improved survivability resulting in increased mission effectiveness. Technology advances anticipated under this program can result in 35% to 60% reductions in aircraft takeoff gross weight and a 25 to 40% reduction in life cycle cost.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	26,693	30,180	31,225	N/A	Continuing	N/A

EXPLANATION: (U) FY 1988 funding reflects Air Force and DoD budget reductions. FY 1987 funding reduced by Congressional action. FY 1986 funding changes were a Gramm-Rudman-Hollings reduction and a reprogramming addition for efforts on National Aerospace Plane technology.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: The exploratory development base for this program is provided by Aerospace Propulsion, PE 62203F and Navy PE 63341N, Materials PE 62102F, and Aerospace Flight Dynamics PE 62201F. Close technical coordination is maintained with the Flight Dynamics Laboratory, Aerospace Structural Materials Program, PE 63211F, and

with the Materials Laboratory. This program is closely related to the Advanced Turbine Engine Gas Generator program, PE 63216F which is managed from the same office and provides the core gas generator development efforts. This program is thoroughly integrated with the Navy component work under PE 63210N Advanced Aircraft Propulsion Systems, which is the basis for a cooperative Air Force/Navy demonstration of advanced engine technology. The Air Force and the Navy currently have a formal Memorandum of Understanding covering efforts under the Joint Technology Demonstrator Engine program. Close coordination is maintained with related efforts conducted by the Army and National Aeronautics and Space Administration. In addition, the Air Force has directed a new initiative that will develop the component technologies aimed at revolutionary changes in turbine engine technologies through FY 2010. This new initiative is called the High Performance Turbine Engine Technologies (HPTET) initiative and will advance aerodynamics, materials, and the innovative design capability such that a minimum weight, high power core technology can be achieved that offers at least 100% improvement over Advanced Tactical Fighter Engine technology. Starting in FY 1988, this effort will become a part of the DOD Integrated High Performance Turbine Engine Technologies Initiative.

6. (U) WORK PERFORMED BY: This program is managed by the Aero Propulsion Laboratory of the Air Force Wright Aeronautical Laboratories, Wright-Patterson AFB, OH. The current contractors involved in this program are: Allison Gas Turbine Division, Indianapolis, IN; Boeing Military Airplane Co., Seattle, WA; Garrett Turbine Engine Company, Phoenix, AZ; General Electric, Evendale, OH; Lockheed, Rye Canyon, CA; McDonnell Douglas, St Louis, MO; Pratt & Whitney Aircraft, West Palm Beach, FL; Teledyne/CAE, Toledo, OH; and Williams International, Walled Lake, MI.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 63202F, Aircraft Propulsion Subsystems Integration (APSI)

A. (U) Project Description: This program provides for the development and functional demonstrations for those advanced technologies which are necessary to assure propulsion and airframe compatibility, and permit the attainment of advanced performance and durability objectives in future aircraft systems. The scope of this program includes: (1) the development of advanced turbine engine components including inlets, fans, power turbines, augmentors, controls, exhaust nozzles, variable cycle concepts, and advanced design concepts; (2) the overall integration of advanced components and design concepts with advanced gas generators to form experimental demonstrator engines to define the flowpath and assess the durability/life aspects of the engine concepts; (3) the overall integration of advanced components materials manufacturing methods and innovative design concepts to demonstrate unique, small, limited-life technologies for both tactical and strategic applications; (4) the definition of improved inlet/engine/exhaust system installation design criteria and propulsion integration techniques; (5) the definition and verification of the methodology to structurally design, analyze, and test turbine engines to achieve increased engine durability, performance, and reduced cost; and (6) the development of improved engine survivability characteristics.

The components being developed will provide the basis for 30-55 percent reduction in supersonic cruise fuel usage, 55-75 percent fewer parts, 60-90 percent increase in engine thrust-to-weight, 2-4 times increased life/durability, reduction in engine life cycle cost and greater airflow matching potential when compared to the most modern engines currently in the inventory. These benefits can be traded off against one another to meet the specific needs of system of interest. This program provides both the critical technology baseline for future system development and a source of data for ensuring the orderly resolution of any propulsion system problems encountered with development engines.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Efforts were initiated under the Expendable Turbine Engine Concept (ETEC) program which are applicable to advanced tactical and strategic missile systems. These efforts can reduce the costs of missile engines by 40-65% and increase missile range by 25%-50%. Advanced augmentor development efforts underway at both General Electric and Pratt & Whitney have completed their preliminary design phase and incorporated unique spraybar/flame holder techniques to operate at high inlet temperatures. Survivability features were an integral part of the design effort. A joint sponsored AF/NASA engine test was continued to demonstrate the feasibility of a carbon-carbon exhaust nozzle. The detailed design of the Thrust Reversing Engine Nozzle Demonstrator (TREND) new start effort at Pratt & Whitney was completed, integrating advanced materials with a unique rotating vane system which can provide both thrust vectoring and reversing capabilities. The Integrated Reliable Electronic Control new start efforts initiated in mid-FY 1985 incorporated advanced electronic packaging techniques and fault-tolerant design methodology. These electronic control efforts are in support of the DOD initiative for improved reliability and maintainability. Under the General Electric Fan Durability Assessment program, an advanced fan component has been fabricated and instrumented for rig test to compare structural prediction with measurements under distorted inlet conditions.

(2) (U) FY 1987 Program: The initial assessment of a new Joint Technology Demonstrator (JTDE) configuration at the Garrett Turbine Engine Company which emphasizes minimum parts and stage count and includes an advanced mixed flow fan component is planned. JTDE new start efforts will be initiated during this time period and will emphasize the achievement of a major improvement in thrust-to-weight capability, reduced parts count and higher dry supersonic cruise capability. Ongoing JTDE programs will include the assessment of an advanced metal matrix composite fan in a comprehensive flight envelope test effort at the new Aero Propulsion System Test Facility at Arnold Engineering Development Center. Other JTDE tests will assess the durability of advanced augmentor liner designs and a new variable area mixing plane system. The ETEC demonstrator program will continue with detailed design and fabrication of advance component configurations for planned FY 1987-1988 testing. The thrust reversing TREND nozzle will be fabricated and instrumented in preparation for FY 1987 engine testing. Fault tolerant electronic fuel controls will be fabricated and initial subsystem checkout testing will be completed. Propulsion integration technology and component designs for supersonic installation will be completed. A new start addressing high Mach propulsion integration for both aircraft and missile application will be initiated.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Technical efforts during this time frame will bring to fruition many of the previous year's programs and the preliminary design of a new generation of component technologies responsive to advanced Air Force needs as indicated by Forecast II projections. Ongoing efforts include the test and assessment of four ETEC demonstrators, engine test of the TREND thrust reversing nozzle and up to 2000 hours of Combined Environmental Reliability Testing (CERT) of the advanced fault-tolerant electronic fuel controls. New start system responsive component efforts will emphasize the integration of innovative structural design techniques with advanced composite, intermetallic and nonmetallic materials to permit near-stoichiometric operating temperatures, very high thrust to weight for Short Take Off, Vertical Landing (STOVL) capability, increased Mach dry supersonic cruise capability, and up to Mach 6 operation with combined engine cycles which also provide excellent subsonic fuel consumption characteristics. Specific examples of technologies planned for assessment include swept hollow fan blading, constant-flow high Mach compression systems, reinforced wound rotors, multi-alloy bladed disks and bladed rings, ceramic turbine stators, uncooled low pressure turbines, integrated electronic/fiber optic fuel controls, thrust-balancing bearing designs which can substantially reduce static frame loads and weight, hyperburners to permit high Mach operation and STOVL thrust vectoring systems. Joint Air Force/Navy new start efforts will be pursued in the survivability area for both inlet and exhaust systems. Cost estimates for the APSI program are based on contractual commitments which extend through FY 1989, plus historically based cost estimates for a level of effort which is included in the APSI Five Year Plan as directed the APSI Program Management Directive. New Start cost estimates are based on past competitive efforts of a similar nature.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The FY 1989 program will be a continuation of technology demonstrations from prior contracts and initiation of follow-on efforts in the Expendible Turbine Engine Concepts (ETEC) Demonstrators and a new start for a High Mach Demonstrator program. Initial demonstration of advanced component technologies responsive to the High Performance Turbine Engine Technology (HPTET) initiative will be conducted in a new generation of Joint Technology Demonstrator Engines (JTDE). Starting in FY 1988, the HPTE efforts will become a part of the DOD Integrated High Performance Turbine Engine Technologies initiative. Advanced fault tolerant electronic fuel controls will undergo their initial engine demonstrations on the JTDEs. High Mach component development such as hyperburners and advanced nozzle concepts will be initiated for subsequent demonstration in the high Mach demonstrator program. The follow-on ETEC programs will continue to play a leading role in defining advanced component materials/manufacturing process assessment critical to HPTET goals for subsequent man-rated demonstrations in Advanced Turbine Engine Gas Generator and JTDE.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones:

Milestones		Dates
(1) Arnold Engineering Development Center/Aeropropulsion Systems Test Facility	*(August 1986)	October 1986

Milestones		Dates
(2) Advanced Electronic Control System (INTERFACE II) Reliability and Maintainability Demo	*(June 1987)	October 1987
(3) Expendable Turbine Engine Concepts Demo		September 1988
(4) JTDE Hi-Efficiency Swept Fan Test		December 1988
(5) JTDE High Mach Demonstrator - Initial High Performance Turbine Engine Technologies	*(September 1991)	September 1990
(6) JTDE STOVL Demonstrator - Hi Bleed Vectored Thrust System		February 1991

* Date presented in FY 1987 Descriptive Summary

(U) Explanation of Milestone Changes

(1) Fuel control delay.
(2) Fairchild 9450 processor chip delay.
(5) Initial technology shifted from generation 6 to generation 5 Joint Technology Demonstrator Engine.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63203F Title: Advanced Avionics for Aerospace Vehicles
DOD Mission Area: 551 - Electronic and Physical Sciences (ATD) Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
		******	******				
TOTAL FOR PROGRAM ELEMENT		27,324	41,900	36,635	41,643	Continuing	N/A
666A	Advanced Reference System Development	2,840	Transferred to PE 63253F			N/A	N/A
			******				
69CK	Advanced Devices	6,209	5,900	5,068	5,886	Continuing	N/A
69DF	Advanced Weapon	2,800	4,546	3,700	2,500	Continuing	N/A
665A	Reconnaissance Sensors/Processing Technology	3,093*	5,121	5,276	7,200	Continuing	N/A
1177	Non-Cooperative Identification Techniques	0**	3,589	5,330	6,700	Continuing	N/A
2334	Airborne Radar Electronic Counter-Countermeasures	0***	3,770	6,185	7,600	Continuing	N/A
2347	Optical Counter-Countermeasures	0***	2,467	3,360	3,700	Continuing	N/A
2733	Advanced Reconnaissance/ Strike Radars	12,382	8,875	Transferred to PE 63253		N/A	N/A
2877	Cruise Missile Advanced Guidance	0****	7,632	4,700	4,797	Continuing	N/A
2345	Airborne Imagery Trans-Mission System	0*****	0*****	1,868	2,185	Continuing	N/A
2746	Low Probability of Inter-cept Communications	0*****	0*****	1,148	1,075	Continuing	N/A

*Funds are in PE 63208F
**Funds are in PE 63742F
***Funds are in PE 63750F
****Funds are in PE 63319F
*****Funds are in PE 63253
******Prior years reflect FY 1988 Science and Technology restructure for comparability purposes only.

Program Element: 63203F Title: Advanced Avionics for Aerospace Vehicles
DOD Mission Area: 551 - Electronic and Physical Sciences (ATD) Budget Activity: 2 - Advanced Technology Development

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The threat posed by Soviet and Warsaw Pact forces is steadily increasing in both quantity and quality. Countering threats postulated for the nineties will demand significant enhancement of our tactical and strategic avionics. This program element is the principal Air Force source of advanced aerospace avionics technology for reconnaissance, image processing, target acquisition, precision terrain-based navigation and weapon guidance, weapon delivery, and fire control for both air and ground targets and noncooperative identification of airborne targets. The PE also addresses the development of key electronic devices for aerospace vehicle applications such as radar, weapon delivery, reconnaissance, surveillance and electronic warfare at the sub-subsystem level. Some of the devices developed include military qualified magnetic bubble memories, solid state transmit/receive modules for advanced radars, tunable laser sources, etc. The PE is a Science and Technology effort.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	21,208	49,835	43,925	N/A	Continuing	N/A

EXPLANATION: FY 1986: Common Signal Processor (CSP) effort required an additional 2,122. An unfunded requirement for the Ultra Reliable Radar was also funded for an additional $2,245 in FY 1986. FY 1988 and FY 1989 reductions were result of a general reduction in science and technology programs.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: PE 62204F, Aerospace Avionics, provides supporting exploratory development for this program element. Efforts transitioned from PE 62204F include work on solid state active aperture arrays for high reliability airborne radars, a family of standard high speed analog-to-digital converters for avionics subsystems and an advanced multiple target attack fire control system using synthetic aperture radar weapon cuing. Advanced component development essential to this program is received from Advanced Electronic Devices for Aerospace Vehicles, and PE 63452F Very High Speed Integrated Circuits. Project 69DF, Air-to-Air Attack Management, will feed PE 63205F, Integrated Control Avionics for Air Superiority (ICAAS) which is developing the total integrated tactical air-to-air capability for transition to the Advanced Tactical Fighter, F-15 and F-16. Project 665A technology transitions to PE 64710F, Reconnaissance Equipment and will provide the sensor/processing technology for PE 63239F, Unmanned Reconnaissance Vehicle and PE 27217F Follow-On Tactical Reconnaissance System. Project 1117 efforts are closely coordinated with the Tri-Service Combat Identification System program. Project 2334 transitions advanced ECCM technology to PE 64210F, Aircraft Avionics Equipment Development and Project 2437 feeds advanced Electro-Optical Counter-Countermeasures to PE 64710F, Reconnaissance Equipment. Project 2877 Cruise Missile Advanced Guidance (CMAG) continues development of autonomous terminal homing (ATH) technology sponsored by DARPA under PE 62301E. PE 62204F, Aerospace Avionics, provides supporting development for this program element. Related efforts in PE 62204F include work on solid state, active aperture arrays for high reliability airborne radars and the development of standard, high speed analog-to-digital converters for avionics subsystems. PE 63452F, Very High Speed Integrated Circuits, provides supporting technology developments, such as sub-micron feature size chips for next generation radar processors to be developed in this program element. This program supports several Air Force Project Forecast II initiatives such as Wafer-Level Union of Devices; Fail-Soft, Fault-Tolerant Electronics; and Smart Skins for advanced aircraft. The Integrated Control/Avionics for Air Superiority

program provides 63205F, Aerospace Vehicle Technology and 63245F, Advanced Flight Vehicle Integration, basic avionics integration algorithms for development and flight test.

6. (U) WORK PERFORMED BY: The Air Force Wright Aeronautical Laboratories/Avionics Laboratory, Wright-Patterson AFB, OH, under the overall management of the Air Force Systems Command, Andrews AFB, MD, manages the projects in the Advanced Avionics for Aerospace Vehicles program. Contractors include: Westinghouse Electric Corp, Baltimore, MD (Project 2334); Hughes Aircraft Company, El Segundo, CA (Projects 665A, 69DF, 1177, 2334, 2347); General Dynamics Corporation, San Diego, CA (Project 2877); and McDonnell Douglas Corporation, St. Louis, MO (Project 69DF and 2877). An additional 15 other contractors have contracts with a face value of $44.3M.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 69DF, Advanced Weapon Delivery. This project improves the mission effectiveness of USAF combat aircraft by extending the air-to-air and air-to-ground operational capabilities of sensors and related components, subsystems and technologies that provide improved weapon delivery while enhancing survivability. Paramount to this development is the incorporation of new fire control algorithms and integration techniques to reduce pilot workload while significantly enhancing the man/machine interface. Mission goals within the project area are increased weapon delivery accuracy, enhanced survivability, increased firing opportunities including new launch modes and increased probability of target kill per weapon expended. Specific efforts include the Multiple Target Attack (MULTACK) program which completed the preliminary design and initiated the final design and development of the non-real-time (NRT) simulation. Situational wareness Study was completed which estimated the sensor coverage requirements for multi-target air-to-air engagements. Study results will transition into Air-to-Air Attack Management (AAAM) efforts. AAAM was awarded initially in late FY 1986 to develop algorithms and pilot/avionics interfaces to better equip pilots to win and survive in the high threat environment of the 1990s by providing effective multiple target air-to-air attack capability. The FY 1987 planned program completes the air-to-air attack management design and initiates algorithm and interface development. The MULTACK program is scheduled to complete critical design in FY 1987 and transition the NRT simulation to a real time simulation. The completed system design will be demonstrated and evaluated by Air Force pilots in FY 1988. The AAAM program will complete preliminary software development in FY 1988 and provide this software to PE 63205F ICAAS program. The MULTACK/F-15 DRF (MDRF) and Internetted Fire Control (IFC) efforts will be initiated in late FY 1988. The MDRF program will develop a point design of the MULTACK fire control design to be compatible with the existing and growth versions and the F-15 Dual Role fighter. The IFC program will integrate the multiple target attack and attack management algorithms from the MULTACK and AAAM programs and develop and integrate internetted, multiaircraft multitarget attack algorithms to provide the Air Force with fire control capability for advanced multi-mission aircraft. The IFC program will continue through 1992. In FY 89, the basic AAAM program will complete preparation of a multi-station man in-the-loop simulation and begin evaluation of AAAM-developed algorithms and pilot/avionics interface concepts. AAM support of the ICAAS program will continue throughout the FDY 89 to FY 91 period. In addition to the above programs, this project will begin investigating proposed fire control concepts for attacking relocatable targets.

B. (U) Project: 665A, Reconnaissance Sensors/Processing Technology. This project provides the technology base

for new and improved targeting and reconnaissance sensors and real-time automatic target recognition and processing systems. It supports essential system improvements in fusion and automation of information processing, and support for battle management and aircrew decision making. In FY 1986, development of the Advanced Target Acquisition Sensor (ATAS) continued. ATAS is a second generation Forward Looking Infrared (FLIR) sensor optimized for automatic processing. Infrared imagery is being uniformly coded to support the infrared imagery data base for second generation FLIR test and evaluation. Fabrication of advanced automatic target recognizer (ATR) systems using Very High Speed Integrated Circuits (VHSIC) technology and currently available microprocessors continued, as did the development of advanced algorithms for automatic target detection and classification. In FY 1987/88, the Imaging Sensor Autoprocessor (ISA) programs will continue and demonstrate both the algorithms and hardware prototypes for automatic detection, classification, and tracking of multiple targets from FLIR imagery. The ATR will be mated with a second generation FLIR for data gathering and evaluation. The development of an integrated ATR/FLIR system is critical to the success of tactical and strategic air to ground missions. Development of a new low cost down looking infrared sensor optimized for real-time reconnaissance from both unmanned and high performance manned vehicles starts in FY 1988. This effort supports the Advanced Tactical Air Reconnaissance System (ATARS) PE 27217F by addressing deficiencies remaining and maintaining compatibility with the ATARS interface requirements. The effort is slated to continue through FY 1992. FY 1988/89 marks the start of a major thrust to provide an automated multiple sensor targeting technology. This program, entitled the Combined Sensors Program, will address the technologies necessary for search and track in adverse weather and in countermeasure environments. The Combined Sensors thrust will also improve detection and classification probabilities. A simultaneous reduction in false alarms, as compared to current single sensor (e.g., FLIR only or RADAR only) automatic targeting systems, is also achieved. These results are made possible by fusing the outputs of multiple sensors to make targeting decisions. Improved immunity to active and passive countermeasures and camouflage, concealment, and deception measures will also result. This improved automatic targeting capability will allow the Strategic Relocatable Target mission to be accomplished. It does so by providing an improved target search and strike capability which puts any ground-based targeting option at risk.

C. (U) Project: 1177, Noncooperative Identification (ID) Techniques. This project develops and demonstrates the avionics technology base required to achieve positive, high confidence, noncooperative identification of airborne targets at ranges compatible with our tactical air-to-air missiles, day or night, in adverse weather, and in high threat, multiple target arenas. The project is developing ID technology so that weapons can be employed at their maximum capability and not be limited by a requirement for visual identification prior to engagement. A payoff of the ID technology development is an improvement in pilots' situational awareness which results from the increased display of targetrelated information. In FY 1986, the project demonstrated a far-term integrated identification capability by conducting a pilot-in-the-loop simulation of projected advanced fighter avionics, target identification sources and tactics; developed and evaluated two signal processing computer algorithms for non-cooperative target identification using ultra-high range resolution (UHRR) radar techniques; established specifications for advanced development of electronic and software interfaces with an integrated target identification system. In FY 1987, the second phase of UHRR will be initiated. In this phase, target attribute data will be collected using a specially modified radar during training exercises on an Air Combat Maneuvering Range, allowing minimal cost data collection. Target signatures will be modeled and previously developed target recognition algorithms evaluated. Studies will be initiated to examine

infrared recognition of air target attributes or signature to assist passive, noncooperative target identification. Also in FY 1987, a risk reduction effort will be initiated to design the antenna, radome and cooling system needed to demonstrate the final design of a passive identification system that combines the Radar Warning Receiver and Fire Control Radar in the F-15 weapon system avionics. The goal of the program is to demonstrate that this passive identification capability can be introduced into the F-15 fleet with low risk. Further a utility analysis will be performed to quantify the payoffs associated with combining information from the radar warning receiver and fire control radar for passive or low probability of intercept identification. A study will be initiated to establish feasibility of exploiting additional aircraft characteristics for combat identification. In FY 1988, a program will be initiated to improve present multiple source, multiple target correlation algorithms by incorporating recent advancements in decision theory. New algorithms will be required to perform under conditions of missing or uncertain data, data with varying degrees of accuracy and arriving at different or variable data rates. A flight test program to demonstrate air-to-air target identification using the ultra-high range resolution mode in a fire control radar will be initiated. This three-year program will demonstrate that the special waveforms are compatible with the multiple target tracking modes of an air intercept radar and that real-time processing of the multiple target identification data is possible. The FY 1989 planned program will initiate technology development for autonomous aircraft use of space- or ground-based indirect target identification capabilities and continue the FY 88 UHRR test program. Cost estimates are based on contracts for similar work and are Category III, Budgetary.

D. (U) Project: 2334, Airborne Radar Electronic Counter-Countermeasures (ECCM). This project develops ECCM technologies and concepts used to reduce susceptibilities of current and future airborne weapon systems to enemy electronic countermeasures and supports the USAF Airborne Radar ECCM Master Plan. In FY 1986, the program began joint Air Force/Army rooftop/flight evaluation of Passive Situational Awareness (PSA) key elements; initiated joint Air Force/Navy offensive ECCM equipment development; continues the joint Navy/Air Force ECCM assessment and data base development using the F/A-18 radar; began the Electronic Combat Multi-function Radar (EMR) development to implement a new radar design concept established under the Adaptive Agile Radar ECCM Concept (AAREC) effort and which will integrate efforts previously developed under the Project - spread spectrum waveforms, simultaneous transmit and receive capability, PSA, adaptive/wideband system technology, and advanced ECCM techniques - to provide an airborne radar offensive ECCM capability for the 1990s. The FY 1987 program continues to develop and demonstrate key technologies for an offensive ECCM radar capability; continues advanced ECCM technique evaluations and transitions where appropriate; continues an unconventional radar design specifically addressing ECCM. The FY 1988 and 1989 programs continue these development programs and final evaluation/demonstration of radar ECCM techniques will be completed and transitioned where appropriate. In the out years, additional ECCM technique developments will be initiated based on new/updated data obtained from the Radar ECCM Assessment Program (REAP/Project 3090) and the hardware development/demonstration for the EMR will be accomplished. Cost estimates are based on contracts for similar work and are Category III, Budgetary.

E. (U) Project 2347, Optical Counter-Countermeasures (OCCM). This project develops electro-optical (EO) CCM technologies applicable to advanced weapon/reconnaissance systems (F-15, F-16, B-1B, ATF, etc.) to reduce vulnerability and mission degradation in a hostile EO environment. Involved is the total sprectrum of EO systems, such as Forward Looking Infrared (FLIR), carbon dioxide (CO_2) laser radars, Infrared Search and Track, laser designators, etc. In FY 1986 demonstration of countermeasures (CM) hardened FLIR technology and development of required countermeasures began

and vulnerability assessment of target recognizers and CM vulnerability assessment of CO_2 sensor continued. Also, began an evaluation of the effects of camouflage, concealment, and deception (CC&D) on current and projected target recognizer electro-optical sensors (USAF/Federal Republic of Germany cooperative effort). The FY 1987 planned program will complete CM hardened FLIR demonstration; continue target recognizer vulnerability assessment. The FY 88 program continues the target recognizer vulnerability assessment, will complete the CO_2 sensor assessment, initiates CO_2 sensor throughout CCM techniques development, and also initiates the multi-sensor exploitation concept. These two efforts continue the FY 89 to FY 92 period. The multi-sensor exploitation efforts combine the past-proven technologies of this project (FLIR, CO_2, ATR, etc) and merges them to define/demonstrate a concept that will be "hardened" against all battlefield countermeasures. Cost estimates are Category III, Budgetary.

F. (U) Project 2877, Cruise Missile Advanced Guidance (CMAG). This project develops navigation and guidance technology needed for low altitude cruise missile penetration of high-threat environment and for precision attack of high-value targets. The multi-purpose CO_2 laser radar guidance technology will provide: 1) precision terminal homing for delivery of nonnuclear warheads, reduction of collateral damage in sensitive target areas, and destruction of hard strategic targets with smaller nuclear warheads; 2) improved midcourse navigation to increase route flexibility and reduction of mission planning time and cost; 3) terrain following/obstacle avoidance to enable reduction in flight altitude and corresponding increase in missile survivability; 4) mobile target identification/submunition aiming for attack of multiple strategic relocatable targets; and 5) retargetting of previously attacked but undamaged critical targets. The program includes design, fabrication, and flight test demonstration of two competing brassboard guidance systems. Defense Mapping Agency (DMA) has completed preliminary assessment of mapping product requirements. In FY 1986 development of flight test units was completed and ground test validation of subsystems performance were initiated. Flight test facilities have been selected and demonstration plans completed. Participation by DMA and potential using commands was increased for validation of mission planning approach and identification of preferred weapon applications. US Navy participation remains to be formalized. In FY 1987, and continuing in FY 1988, flight test demonstration will begin for the highest priority guidance functions. The contractors will develop designs for integration of advanced guidance systems into specific cruise missile airframes. CMAG for low altitude cruise missiles is finished in FY 89 with completion of comprehensive flight test of all guidance functions, development of performance prediction models, and completion of US Navy sponsored tests. Project 2877 continues in FY 89 with initial development of flight test demonstration and strategic mission guidance avionics concepts for long range unmanned hypervelocity vehicles. Concepts for real-time targeting and autonomous weapon mission planning will be pursued. These activities will continue through out years with application of brilliant guidance technology to strategic autonomous reconnaissance and strike airframes and the development of hypervelocity vehicles. Cost estimates are Category III, Budgetary.

G. (U) Project 2345, Airborne Imagery Transmission System. This project provides the advanced data link technology required to counter the Soviet threat during the late 1980s and after. Program emphasis will be placed on antenna nulling and beam forming, information compression, wide band and extremely wide bandwidth spread spectrum modems, focal plane technology and data link evaluation technologies. These modular techniques will be developed within an architecture that will allow a modular employment and enhancement as new technologies and threats arise. This project emphasizes reconnaissance applications, particularly air-to-air links. Additional efforts include characterization of the multibeam antenna array developed by the Lincoln Laboratory and an assessment of its capability for

use in this program. The FY 1986 program continued development of the air-to-air data link and completion of the flight tests of the air-to-ground data link. The FY 1987 planned program includes continuation of design/development/fabrication of the brassboard air-to-air data link and planning for integration and flight test of the entire system in jamming environment. The FY 1988 program completes fabrication of the air-to-air brassboard and begins integration of the air-to-air and air-to-ground links in preparation for the planned flight test series. Cost estimates are based on contracts for similar work and are Category III, Budgetary.

H. (U) Project: 2746, Low Probability of Intercept (LPI) Communications. As future aircraft make increasing use of low observable (stealth) technology, the radio signals from the aircraft communications systems become the main remaining detectable feature of the aircraft. This program will provide the jam resistant LPI communication system technology necessary to reduce the physical vulnerability of airborne platforms to detection, location and subsequent destruction through exploitation of radio signals. This technology program will augment other low observables avionics programs by ensuring that communication emanations are not the "weak link" to negate the effectiveness of stealth vehicles. It will also develop improved Electronic Support Measures (ESM)/Signal Intelligence receiver technology for detection, location, and tracking of spread spectrum emitters. The Air Force has ongoing programs to develop an antijam (AJ) communication capability--e.g., Joint Tactical Information distribution System (JTIDS), and Enhanced JTIDS system. These future spread spectrum radio waveforms will provide some LPI capability; however, the high transmission power requirements to achieve an AJ capability is not consistent with the need for reduced avionics and communications observables. This project was created to address this need and at the same time support Tactical Air Forces Required Operational Capability 321-75, Jam-Resistant Secure Voice Communication. The FY 1986 program completed low probability of intercept (LPI) technology assessment, electronic support measures design and vulnerability assessment efforts; initiated development/fabrication of a multi-mode LPI communication terminal brassboard to demonstrate the feasibility of integrating multiple LPI communication techniques; and continued test planning. The FY 1987 planned program includes continuation of development/fabrication of a multi-mode LPI communications terminal brassboard and continuation of test planning. The FY 1989 program initiates flight testing. In FY 1990 and beyond, the program refines the LPI communications techniques and signal structures based upon the the test results and prepares the signal waveforms for integration into integrated avionics systems. Cost estimates are based upon the costs of similar contracts and are Category III.

I. (U) Project: 69CK Advanced Devices. This project is the principal Air Force source of key electronic device development for aerospace vhicle applications such as radar, weapon delivery, reconnaissance, and electronic warfare at the subsystem level. The requirements for devices developed in this project stem from purely military needs that cannot be satisfied by commercially available devices. Advanced electronic devices developed in this project include military qualified magnetic bubble memories, solid state transmit/receive modules for airborne radars. Tunable laser sources and detectors for airborne electro-optical countermeasure applications, and power supplies for low voltage, high current Very High Speed Integrated Circuit applications. In FY 1987 solid state active element phased array antenna development using hybrid technology will be completed. The Monolithic Microwave Integrated Circuit (MMIC) technology effort will begin in FY 87. Fabrication and test of the thermo-electrically cooled detector will be completed in FY 88. Power supply circuit design and fabrication of essential power supply components for use in submicron VHSIC radar processors will be completed and demonstrated in the laboratory in FY 1988. Lab demonstrations

of military qualified magnetic bubble memory devices will be completed by end of FY 1988. Work will be initiated on advanced signal processors providing high speed, real-time outputs for airborne radar and other avionics functions, based on Very High Speed Integrated Circuits (VHSIC) submicron technology. In FY 1989 development will continue on the multifunction, frequency agile source for application to electro-optics countermeasures, laser radars, laser communications, guided bombs and range finders. Also in FY 1989 a new start is planned which will develop hetero-junction integrated circuit techniques. These new devices offer, the potential of significantly higher speeds.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: The United States Air Force and the Ministry of Defense, Federal Republic of Germany have established a cooperative Project of Research in the Field of Camouflage, Concealment and Deception (CC&D) Techniques pertaining to the Infrared Spectrum and related to Fixed and Mobile Military Installations. The principal participants are the Avionics Laboratory at Wright-Patterson AFB OH and the Forschunginstitut fur Optik (FfO) in Tubingen GE. Each participant is funding their own research. There are no plans for exchange of funds. The US is presently spending about $700K per year in this area. Cooperation thus far has been in the form of joint data collection episodes in Germany with US and German crews sharing the data collection tasks and, after data reduction, exchanging reports. The Memorandum of Understanding under which this cooperative effort exists, was signed in 1986 and will expire (unless renewed) in 1991.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63205F
DOD Mission Area: 553 - Engineering Technology (ATD)

Title: Aerospace Vehicle Technology
Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate*	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	25,373	23,357	27,220	28,260	Continuing	N/A
2251	Nonnuclear Survivability Technology Development	1,765	1,460	985	0	0	10,305
2506	Control of Flight	15,575	14,625	9,985	6,056	Continuing	N/A
2507	Vehicle Equipment	1,200	800	0	0	0	7,390
2508	Aeromechanics	50	0	0	0	0	50
2899	Aircraft Battle Damage Repair	1,191	944	5	0	0	7,767
2978	Reliability and Maintainability for Flight Vehicle Technology	2,600	942	3,595	3,940	Continuing	N/A
3197	Advanced Flight Technology Integration/F-16 Support	970	0	0	0	0	10,864
3416	Boost Glide Vehicle Technology	22	2,249	6,618	14,086	Continuing	N/A
3422	Integrated Control/Avionics Technology	2,000	2,337	6,032	4,178	Continuing	N/A

* Subsequent to submission of the R-1, $1.7 million has been reprogrammed into the program element bringing the total to $23.357 million for FY 1987.

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: In response to the Congressional desire to reduce the number of Program Elements, PE 63205F now reflects the fusion of PE 63244F, Aircraft Nonnuclear Survivability, into the former PE 63205F, Flight Vehicle Technology, and the combination is now retitled Aerospace Vehicle Technology. The activities formerly funded under PE 63244F, Projects 2251 and 2899, will be merged with Project 2978, Reliability and Maintainability for Flight Vehicle Technology. This merger will be completed by FY 1989. This Science and Technology program develops combinations of subsystems that address specific aspects of the aerospace mission (tactical delivery, air superiority, air defense, battle damage repair and maintenance). These subsystems are then incorporated in large scale system integration and flight validation programs (primarily Advanced Flight Technology Integration, PE 63245F). For example, in PE 63245F, subsystem integration of flight and propulsion control combined with vectored thrust provides improved air combat maneuverability, increased range and performance, and a short takeoff and landing capability. Subsystem integration is essential to realize synergistic effects of technologies in flight control, fire control or avionic sensors, structures, and aerodynamic configurations developed under PE 63205F. This program element provides subsystems to, and works in conjunction with, PE 63245F to integrate and flight validate overall systems payoffs. This combination has been highly successful in transitioning technology into weapon systems. The individual efforts in this program element are timed to meet the technology needs of both existing and planned future weapon system acquisitions.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
RDT&E	22,632	30,027	27,850	N/A	Continuing	N/A

EXPLANATION: Data shown for combination of PE's 63205F/63244F and FY 1986/1987 Congressional reduction.

4. (U) OTHER APPROPRIATION FUNDS: Not applicable.

5. (U) RELATED ACTIVITIES: PE 63205F (and the former PE 63244F) provide proven component technologies for subsequent system-level integration, primarily within the Advanced Flight Technology Integration program, PE 63245F. Jointly funded programs include the Short Takeoff and Landing/Technology Demonstrator, the Integrated Control/Avionics for Air Superiority program, the Boost Glide Vehicle (BGV) program, and the Self-Repairing Flight Control System (SRFCS). PE 63253F, Advanced Avionics Integration, also provides basic avionics algorithm development to PE 63205F and 63245F. SRFCS is also part of the coordinated Department of Defense effort to improve the reliability/maintainability and survivability of future weapon systems. Contributory technology is funded in PE 63211F, Aerospace Structure and Materials and PE 63203F, Advanced Avionics for Aerospace Vehicles. The above efforts are coordinated with Army and Navy requirements and programs at a tri-service planning meeting held each summer.

6. (U) WORK PERFORMED BY: This program is managed by the Flight Dynamics Laboratory, Wright-Patterson AFB, OH. Flight testing is conducted at the Air Force Flight Test Center, Edwards AFB, CA, with support from National Aeronautics and Space Administration. Contractors are Boeing Co., Seattle, WA (2507, 2251, 2899, 3422, 2978); General Dynamics Corp., Ft Worth, TX (3197, 3422, 2506); McDonnell Douglas Co., St. Louis, MO (2506, 3422, 2978); Martin Marietta Corp., Orlando, FL (3426, 3422), and Pratt & Whitney, West Palm Beach, FL (2251). There are eight other contractors, with total dollar value of $2 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 2251, Nonnuclear Survivability Technology Development. This project funds the Air Force share of the Tri-Service Program in Aircraft Nonnuclear Survivability established by the Joint Logistics Commanders and directed by the Joint Technical Coordinating Group for Aircraft Survivability. The joint survivability program was established to: (1) coordinate individual service programs to increase the survivability of aeronautical systems to nonnuclear threats; (2) develop efforts to complement the Service's survivability programs in the area of technology, damage assessment methodology, design criteria and specifications and standards; and (3) maintain close liaison between the Services to ensure that all survivability research and development data and systems criteria are made available to the aircraft designers. To meet the above objectives, the following goals have been established: (1) support

development of reduced engine signature to decrease detectability (by homing missiles) and increase countermeasures effectiveness; (2) coordinate individual service programs, and disseminate the survivability technology developed by the Services; (3) develop projectile and fragment resistant advanced composite fuel tank structure for advanced tactical aircraft to ensure emerging composite material and structural designs are tolerant to projectile damage as well as to damage caused by the everyday environment. In FY 1986, completion of the packaging design for a pyrotechnic expendable jammer to counter laser guided missiles was accomplished. In FY 1987 the following major activities are planned: demonstration of advanced engine signature reduction technology; completion of the Air Force portion of the program to demonstrate application of the On-Board Inert Gas Generating System technology for tactical aircraft fuel tank fire suppression; continuation of the less-vulnerable composite compression structures development; and completion of the engine compartmental fire extinguishing capability evaluation. FY 1988 plans include completion of advance engine signature reduction technology development and completion of the less-vulnerable composite compression structure development. By FY 1989 the remaining activities will have been incorporated into Project 2978 in this same PE.

B. (U) Project: 2506, Control of Flight. This project provides critical development of Short Takeoff and Landing technologies. This project uses Ada software language and knowledge based diagnostics to demonstrate the benefits of direct linkage of the flight control system to propulsion control. Without this synergism, the workload, during combat or emergencies, exceeds the abilities of the pilot to use an aircraft's full capabilities. Subcomponents and individual technologies for a Short Takeoff and Landing/Maneuver Technology Demonstrator aircraft (modified F-15) are being developed in this project. These include subsystem development of flight controls, vectored thrust, propulsion, braking and pilot/vehicle interface in the cockpit. When integrated and flight validated in PE 63245F, Project 2682, these technologies will produce an aircraft that can: (a) be controlled at any altitude, airspeed, or attitude by vectoring the thrust and can outperform any aircraft configured solely for aerodynamic control; (b) use vectored propulsion in-flight to enhance maneuverability and reduce fuel consumption caused by aerodynamic drag; (c) control the thrust required, while maintaining constant engine revolutions per minute, thereby allowing in-flight thrust reversing and improved energy management during combat, takeoff/landing, and cruise; and (d) takeoff and land on an icy runway, only 1500 feet by 50 feet wide, in up to a 30 knot crosswind without the aid of ground support such as a microwave or instrument landing systems. This circumvents enemy runway denial tactics or allows dispersion to austere operating bases. In FY 1986, a breakthrough in aircraft engine nozzle design lead to significant weight reductions. Using advanced cooling techniques in a metallic nozzle, this program demonstrated that it is now possible to design and build vectoring and reversing nozzles light enough for use on supersonic air superiority fighters. In FY 1987, delivery of long-lead items will be completed and modification to the F-15 airframe will begin. This will include the installation of two modified F-18 horizontal tails as canards, and modification of the aircraft tail and engine supports to accommodate a rectangular nozzle for thrust vectoring. New landing gear and hydraulic systems will be installed. Full scale engine tests, including control software, will begin in FY 1987. In FY 1988, Integrated Flight Propulsion Control system software development and verification activities will be completed and flight clearance for the control system and the cockpit displays will be attained. A piloted simulation with actual flight hardware to verify the development of the control system and pilot displays will include predicted flying qualities and failure modes throughout the total aircraft mission. The following subsystem tests will be conducted: (1) on aircraft ground tests, e.g., verify stability margins, etc; (2) taxi tests of the integrated braking and steering; (3) tests to demonstrate the benefits of the control system in terms of both flying qualities and performance for both cruise and combat

modes of operation; (4) tests to demonstrate the benefits of the control system and special cockpit displays for the Short Takeoff and Landing/Maneuver Technology Demonstrator (STOL/MTD) modes, including approach, guided flare to a precise touchdown, and ground rollout using maximum reverse thrust on a slippery runway in the presence of crosswinds, wind shear, microbursts, and gusts. Updates to the Integrated Flight Propulsion Control software will be implemented as required. Data reduction and evaluation will provide the basis for the integration of flight/propulsion controls on the Advanced Tactical Fighter. Development of software for combat maneuver enhancement will begin. In FY 1989, the STOL/MTD will validate the benefits of integrated flight/propulsion control in combat maneuvers. Landing performance for adverse runway and weather conditions will be validated. Tests to isolate contributions of the various individual technologies will be conducted, flight tests will develop techniques that will maximize the benefits of the technologies, determine operational usage and verify that the technologies are mature enough for operational application Flight tests in this phase will include sorties flown by operational fighter pilots. Final program documentation will be written and transition of the technology to industry and appropriate government agencies will occur. Contractor and subcontractors are matching the $75 million on contract with $80 million of their own funds.

C. (U) Project: 2899, Aircraft Battle Damage Repair (ABDR). This project provides enhanced and proven techniques, procedures, and design standards to rapidly assess and repair battle damaged aircraft in an intense combat environment. The project extends the existing aircraft battle damage repair capability to more rapidly assess and repair advanced structures, flight control systems, and other flight critical aspects of current fighter aircraft. The project also provides design guides and standards, and a Resource Quantification Methodology that can be applied to future aircraft (such as the Advanced Tactical Fighter) to increase battle damage tolerance, assess repair deferability, determine repair procedures, as well as to validly quantify ABDR resources. FY 1986 accomplishments include development of engine battle damage repair techniques and a static explosive damage simulator for use in ABDR training. Principal goals in FY 1987 include the completion of the ABDR capability study; continuation of the establishment of ABDR evaluation procedures and the resource quantification simulation model development; the initiation of efforts to develop the format for an ABDR design handbook, and the building of an ABDR information base. In FY 1988 the resource quantification simulation model will be demonstrated, an ABDR design handbook format will be completed, and ABDR evaluation procedures will be completed. Work on improving ABDR capability and supporting the ABDR data base will be continued within Project 2978 in FY 1989 and beyond.

D. (U) Project: 2978, Reliability/Maintainability For Flight Vehicle Technology. This project develops component technologies for a Self-Repairing Flight Control System (SRFCS). This consists of reconfigurable flight control and artificially intelligent (AI) maintenance diagnostic technologies. The SRFCS will cut flight control system maintenance to one-seventh of what it is today, increasing aircraft availability and warfighting capability. Using the inherent redundancy in the available flight control surface (ailerons, stabilators, etc.)--instead of redundancy of surface control equipment (servoactuators, hydraulics, etc.)--it will automatically reconfigure the remaining flight control system components to maintain safe flight, although gracefully degrading. Automatic reconfiguration is estimated to be four times safer than today's systems based upon redundancy. To aid flight line maintenance the defective component is identified by the AI diagnostic system, along with the component failure effects on the aircraft and the impact on mission/safety requirements. In combat, the system will reconfigure around battle damage and notify the pilot of the remaining flight control capability. The SRFCS will attempt to restore full control,

monitor further damage, and provide whatever maximum control authority is possible. Systemwide integration and flight test is accomplished in PE 63245F. In FY 1986, preliminary development and evaluation of competitive reconfiguration concepts were completed and selection was made of the contractor team to accomplish the advanced strategy/design for reconfiguring a flight control system after fault/damage. A Knowledge-Based Maintenance Diagnostic System (AI) covering 16 of the 167 fault codes of the F-15 flight control system was demonstrated. A partial reconfiguration strategy was implemented and demonstrated on an unmanned research aircraft following loss of an aileron control surface. A full reconfiguration strategy was operated in real-time with an Advance Flight Technology Integration/F-16 (AFTI/F-16) aircraft model at the Flight Dynamics Laboratory (FDL) Engineering Flight Simulation Facililty. An Expert Maintenance Diagnostic System capable of (1) diagnosing the first 5 percent of the F-16 flight control system and (2) being expanded to reduce the "Cannot Duplicate Fault " problem, was developed and demonstrated on a portable computer. In FY 1987 the AFTI/F-16 computer model and Self-Repairing Flight Control System (SRFCS) will be expanded to cover a large portion of the flight envelope and subjected to sensitivity analyses to establish a baseline for the design criteria experiment. The high risk SRFCS testing on the unmanned research vehicle will be expanded to include a fault detection and isolation module and evaluated against several single and double fault/damage scenarios. The advanced reconfiguration strategy will be integrated in the simulator with a realistic Advanced Tactical Fighter (ATF) computer simulation and operated in real-time in a breadboard flight control computer. The Expert Maintenance Diagnostic System will be expanded to cover 50 percent of the F-16 flight control system with two battle damage assessment scenarios included. In FY 1988 the advanced reconfiguration strategy will be programmed and operated in hardware-in-the-loop simulation tests. These will incorporate an expert system diaggnostics interface. An in-house simulation capability supporting single surface flight testing will be established. A field model of the partial F-16 expert maintenance diagnostic system will be set up at a Tactical Air Command Wing for user assessment and feedback. The laboratory version will be upgraded to 80 percent of the F-16 flight control system. In FY 1989, the design criteria for a self-repairing flight control system, including a reconfigurable flight control design and an expert maintenance diagnostic system, will be produced and available to the ATF. Beginning in FY 1989 and continuing through FY 1992 an aggressive program for the multi-axis flight test effort will be pursued and, at the same time, examination of interaction of the SRFCS with other automatic modes will be conducted to upgrade the design criteria. This software development in the Ada language will be made available for the initial design or retrofit of future aircraft. Development of these subcomponent and individual technologies is accomplished in PE 63205F; full-scale system integration and flight test are supported in PE 63245F.

E. (U) Project: 3422, Integrated Control/Avionics Technology: In conjunction with work in PE 63253F (Advanced Avionics Integration)this project provides supporting technologies for the Integrated Control and Avionics for Air Superiority (ICAAS) program which are integrated and flight validated under PE 63245F. ICAAS will develop and demonstrate advanced flight and fire control capabilites needed to enable fighter aircraft to kill and survive when outnumbered in air combat. The program develops component technologies for the engagement phase of the air-to-air mission, with improvements provided in pilot situation awareness, beyond-visual-range multi-target attack, effective transition to within-visual-range attack, threat missile evasion, and cooperative tasking (internetting) between friendlies. Attack guidance algorithms will be used to develop aids which will assist the pilot in computing weapon launch solution against multiple airborne targets and in positioning the aircraft for successful attack execution. These flight control

laws will maximize launch opportunities while minimizing exposure to threats. An automatic defensive guidance suite, using existing sensors, will be developed for successfully avoiding/evading threat homing missiles. Components are designed which improve multi-sensor data processing and cockpit information display to give the pilot a clearer picture of the battle going on around him. This enhances pilot situational awareness and allows informed engagement decisions. Data link internetting systems for use between friendly aircraft will reduce dependency upon verbal communication, provide coordinated targeting assignments and more effective mutual support. The Ada computer language will be used for all software development, for this, the first Ada application to real-time mission critical integrated control technology. Simulation and flight test experiments will demonstrate the feasibility of fighting outnumbered (four blue versus 16 hostile) and winning with a goal of ten to one exchange ratio. In FY 1986, we completed: (1) a piloted simulation evaluation of multiple target air combat engagement software which can be embedded in the mission computer of fighter aircraft; and (2) a flight test demonstration of Integrated Flight/Fire Control (IFFC) all-aspect air-to-air gunnery software coded in Ada and along with the configuration studies for an electronically scanned array (ESA) radar. In FY 1987, we will complete flight tests of an Ada-based on-board management system capability. Rapid prototyping of Integration of Control Avionics for Air Superiority (ICAAS) system software with preliminary design of the pilot/vehicle interface will begin. In FY 1988, the Air Force and Navy will co-sponsor the first flight test demonstration of Ada language use in real time integrated flight and fire control system for air-to-air gunnery. This will demonstate: (1) validation of the Ada language ability to handle real time data transmission under the combat environment; (2) achievement of four times as many lethal shot opportunities than with current operational systems; (3) reduced weight and complexity by using one multipurpose reference system in place of separate flight control, fire control, and navigation motion sensors; (4) experience using Ada software throughout critical avionics system component. System integration concepts will be expanded into technologies which are capable of computing air-to-air weapon launch solutions against multiple airborne targets at ranges well beyond pilot visual detection. Detailed requirements will be developed for integrating advanced flight guidance and pilot situation display concepts with target detection and missile launch functions developed in the Air-to-Air Attack Management (AAAM) associate contract. In FY 1989, a program design review will be conducted to examine the integration approach defined by each contractor and down-select to a single contractor who will proceed with detailed simulation and flight testing. Modifications to the testbed fighter aircraft will be designed and long lead hardware purchased. Air Combat Engagement System (ACES) software will be prepared for simulation and flight testing. ACES will use synthetic target models to realistically simulate tactical air combat encounters with a configuration totally self-contained to the testbed aircraft. Complete system checks can be performed on the ground without costly support equipment or in the air without the expense of flying target aircraft. ACES can be transitioned to operational use as an embedded testing or training device which would save millions of dollars annually. Total ICAAS system design will be expanded to incorporate cooperation modes (internetting) which allow fighters to exchange digital data transmissions rather than depending upon voice communications. Piloted simulations will be performed which show the feasibility of two internetted ICAAS fighters engaging and defeating up to eight enemy aircraft. During FY 1990, 1991 and 1992, hardware-in-the-loop simulation will be used to integrate hardware and software. The test bed aircraft will be modified, ground tested at the contractor facility, and flight tested at the Air Force Flight Test Center in a realistic multitarget environment.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3416, Boost Glide Vehicle (BGV) Technology.

A. (U) Project Description: A critical effort in the development of component technologies for the Long Range Boost Glide Vehicle (BGV), this program provides hypersonic aerodynamic vehicle design and flight controls subcomponent technologies. Under PE 63245F (Project 3417), BGV combines the maturing technologies of structural carbon/carbon (for a highly efficient, high temperature, lightweight aerodynamic design) and autonomous flight control into an unmanned hypersonic system for flight test. The objective is to demonstrate the technical feasibility and utility of a long range, high mach, maneuvering vehicle for strategic aerodynamic weapon delivery. These subcomponent BGV technology are critical to achieving flight demonstration of the following benefits: validating that a BGV can have twice the range of conventional ballistic missile for a given size launcher; achievement of rapid flight times (fractions of an hour) to reach the target area; assessment of inherent thermal and structural hardness, transcontinental targeting footprint, and high-g terminal maneuver capability to gain a survivable penetration capability; and demonstration of the aerodynamic, structural and flight control technologies needed to design high performance hypersonic manned aircraft. PE 63205F provides funding for subcomponents and individual technologies and PE 63245F provides funding for system-wide integration and flight test.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: An Advanced Development Program Office (ADPO) was formed in December 1985. In FY 1986 the ADPO has concentrated on writing the Draft Statement of Work, Contract Data Requirements List (CDRLs), Work Breakdown Structure, and completing the draft Requests for Proposals (RFP). Draft RFP release occurred in July 1986. Interfaces with other government organizations were established and memorandums of understanding and test plans were finalized with both the National Aeronautics and Space Administration and the United States Air Force's Ballistic Missile Organization.

(2) (U) FY 1987 Program: The prime RFP will be released the third quarter of FY 1987 for both subcomponent and flight validation work. Technical Evaluations and Source Selection will continue through spring and summer. Components for testing expulsion, sensor development, and small missile (internal BGV) carriage development will begin.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: A single contractor will be selected in the first quarter of FY 1988. This contractor will lead a test team to develop the experimental flight test vehicle subcomponent technologies and prepare for vehicle integration and flight test (accomplished under PE 63245F). The contractor will begin subscale tests of structural design concepts. Subcomponent test plans will be completed. Extensive wind tunnel testing and internal configuration/design will begin. Interfaces betweeen the BGV and the test launch vehicle interfaces will be defined in a preliminary design. Navigation, guidance and flight contract initial design and component testing will be carried out. Software architecture and initialization will be accomplished. Long lead materials tooling and subsystem components will be purchased. A systems integration laboratory will be fabricated at the contractor facility. Investigtions will be made of guidance and control hardware and software modifications to

the booster guidance. Other efforts will involve development of software to control launch vehicle nozzles, electrical static, filter modifications and flight control software, trajectory shaping analysis, controls margin analysis, and static trim capability margins. Recovery system planning will be analyzed and parachute testing will be conducted at Air Force Flight Test Center.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Ground testing of components and subsystems will be completed, including hot gas dynamic and static testing of structural components and captive flight testing of the baseline navigation and guidance suite. Design of guidance, navigation and control subsystems will be finalized and bread board components built. Avionics, guidance, navigation, and control testing will commence at the contractor's systems integration laboratory and Holloman Air Force Base/White Sands Missile Range. This will include sled tests at the Central Inertial Guidance Test Facility, and captive flight testing. Recovery testing will evolve from parachute tests to checkout, tow and pull-up recovery tests of a Boost Glide Vehicle (BGV), using Air Force Flight Test Center assets (HH-53 and JC-130). Special test equipment, flight computer, the engineering avionics hot bench, plus other required equipment and software development will continue. Fabrication on subsystem capsule, guidance and navigation and flight control subsystems will begin. Mature software will be tested by the contractor and certified by an independent contractor. Test launcher software and flight control refinement will continue. Final design will be frozen at Critical Design Review in October 1988. High payoff experiments for flight in FY 1992/1994 will be selected Flight planning for the first flight test will be initiated.

(5) (U) Program to Completion: This is a continuing program which will provide component technologies for flight test validation under PE 63245F. After PE 63205F component systems are checked out and integrated, first flight will occur in April 1992, with three succeeding flights at six month intervals. PE 63245F's flight test program is essential to validate these technologies that will meet the Strategic Air Command Requirement. Cost estimates are based on Air Force historical data, a request for information from five contractors, and a joint cost estimate.

C. (U) Major Milestones: Not applicable.

9. (U) COOPERATIVE AGREEMENTS: The Aircraft Battle Damage Repair (ABDR) Advanced Development Technology Program Office was added to Information Exchange Program with the United Kingdom Royal Air Establishment and Data Exchange Agreement with the Federal Republic of Germany Federal Ministry of Defense to facilitate the exchange of ABDR information. The function of the participants is to review ABDR Research and Development programs, exchange information and develop and conduct complementary efforts to enhance ABDR capabilities both separately and collectively.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63211F — Title: Aerospace Structures and Materials
DOD Mission Area: 553 - Engineering Technology (ATD) — Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		19,298	25,242	28,068	33,348	Continuing	N/A
69CW	Advanced Composites	4,199	10,395	10,117	11,375	Continuing	N/A
486U	Advanced Metallic Structures	7,655	9,654	8,710	10,202	Continuing	N/A
2100	Laser Hardened Materials	2,475	4,906	8,064	10,000	Continuing	N/A
3153	Nondestructive Inspection Development	0	287	1,177	1,771	Continuing	N/A
3394	National Aerospace Plane	4,969	0	0	0	Continuing	4,969

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This is the only Air Force program which demonstrates subsystems and components applications in the following areas: advanced structural design concepts, new fabrication technology, hardening techniques against high-energy laser threats, and nondestructive inspection of aerospace structures. These new technologies are required to provide new aerospace systems the capabilities (performance, survivability, reliability, etc.) to defeat validated current and future threats. Metallic, nonmetallic, and laser hardened structures are developed with advanced materials and new fabrication technology and tested to validate technical feasibility and military utility. The result is more damage tolerant and durable structures ready for weapon systems application. Direct benefits are reduced systems cost, weight, and technical risk along with increased systems performance and survivability. Technology is directly applicable to aircraft, missiles, and tactical subsystems to counter both near- and far-term threats including ground- and air-based lasers. Advanced low observable structures developed in this program directly enhance defense penetration and counter radar targeting for surface-to-air missile and interceptors.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	18,084	31,512	32,599	N/A	Continuing	N/A

EXPLANATION: (U) The increase in FY 1986 funding is due to reallocation for the National Aerospace Plane. The decrease in FY 1987 funding is due to Congressional action. The decrease in FY 1988 funding is due to a reduction in Air Force Total Obligation Authority.

4. (U) OTHER APPROPRIATION FUNDS: Not applicable.

5. (U) RELATED ACTIVITIES: Coordination with other Department of Defense and governmental activities is maintained under strong guidance from the Office of the Secretary of Defense's technical staff. Activities such as the Tri-Service

Metal-Matrix Composite Steering Group, the Tri-Service Laser Hardening Materials and Structures Working Groups, and selected activities of the Office of Science and Technology Policy Committee on Materials foster development of a strong nonredundant program. Close relationships are maintained with the National Aeronautics and Space Administration in areas of mutual interest. This program element is meshed with portions of the Air Force Manufacturing Technology Program (PE 78011F) with results of each program element feeding the other, and with Aerospace Flight Dynamics (PE 62201F), Materials (PE 62102F), and Aerospace Propulsion (PE 62203F), each of which provides the basic technology for further development within this program element. The coordinated efforts in laser eye protection supported by Materials (PE 62102F), Aerospace Biotechnology (PE 62202F), Crew Systems Technology (PE 63231F), and Aircrew Laser Protection (PE 64706F, Project 7207) is supported by Project 2100. In addition, the Joint Aero Propulsion Laboratory and Materials Laboratory High Performance Turbine Engine Technologies (HPTET) initiative is supported by Project 486U. The HPTET initiative is an effort to provide the Air force with the technology base necessary for full-scale development of engines with double the propulsive capability. Due to the universal nature of materials and structures and their application, this program element has potential application for most major Air Force acquisition programs. There is no duplication with the Strategic Defense Initiative. All high temperature structures efforts are coordinated with the National Aerospace Plane (NASP) program office to ensure that programs under this PE are complementary to, and not duplicative of NASP development efforts.

6. (U) WORK PERFORMED BY: This program is managed by the Flight Dynamics and Materials Laboratories, Wright-Patterson AFB, OH. The five major contractors include: Lockheed Aircraft Corp, Marietta, GA, Burbank, CA, and Sunnyvale, CA (486U, 69CW); Northrop Corp, Hawthorne, CA (486U, 69CW); McDonnell-Douglas Corp, St Louis, MO, and Huntington Beach, CA (2100, 486U, 69CW); Boeing Aircraft Company, Seattle, WA (486U, 69CW); and Vought Corp, Grand Prairie, TX (486U). There are nine additional contractors with a total contract value of $25.8 million.

7. (U) PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3153, Nondestructive Inspection Development. This project develops and demonstrates advanced nondestructive inspection and evaluation (NDI/E) methods and procedures to accurately monitor performance integrity and to detect failure-causing defects and conditions in weapon system components and materials. NDI/E capabilities greatly influence and/or limit many design and manufacturing processes and maintenance practices. The planned application of significant amounts of composite materials and advanced structural high performance turbine engine alloys into the operational inventory--for example, on the advanced tactical fighter and the advanced technology bomber--demand an ability to perform real-time inspections much faster than our current capability. Comparison of Air Force inspection capabilities with requirements reveals a significant and serious deficiency. Large and relatively accessible cracks are detected now. This project will examine ways to reliably detect cracks that are an order of magnitude smaller and hidden from access by other inspection methods. During FY 1987 a five-year effort to develop and demonstrate advanced applications of x-ray computed tomography (CT) will be initiated. Procurement of test equipment, materials, and components will begin. In FY 1988 the CT effort will continue with advanced CT equipment being employed and/or reconfigured to demonstrate this powerful new methodology on items having inspection requirements exceeding current capabilities. Candidate items for this technology demonstration include complex structures, inaccessible components, components made with advanced composites (including typical low observables), permanently closed systems (such as

thermal batteries), and complex cast components for airframes and engines. Testing will begin with the objective of validating accurate, cost-effective methods that meet "real-life" production and maintenance requirements. A program will be initiated to develop and demonstrate new methods and equipment to perform reliable, rapid, depot-level nondestructive inspection and evaluation (NDI/E) of large composite structures. These methods and equipment will replace current capability which is limited, expensive, labor intensive, and unreliable. In FY 1989, the major testing and validation effort on new computed tomography equipment and procedures will continue. In addition, equipment and materials will be in place to initiate development of advanced NDI/E methods for composite components. New tasks will be initiated to (a) develop a field-portable system to provide more rapid, less costly X-ray NDI/E than currently available; (b) develop and demonstrate significantly more accurate turbine engine component NDI/E instrumentation and data analysis methods in order to keep pace with next generation propulsion system reliability and maintainability requirements.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2100, Laser Hardened Materials

A. (U) Project Description: This project develops and demonstrates materials and design concepts for protection against laser radiation effects applicable to various aerospace system components including tactical optical subsystems, reconnaissance subsystems, personnel protection, and aircraft critical components. A significant near-term threat exists to personnel and optical sensors (infrared, television, etc.) and a later-term threat to structures. Aircrew members operating tactical aircraft desperately need protection in order to eliminate the probability of being blinded by even low powered laser devices--which would cause loss of aircraft and prevent mission accomplishment.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: An effort was completed that developed hardened subsystems for the infrared (IR) seeker of the IR Maverick missile. A hardened, forward looking, infrared pod for the low altitude navigation/targeting night attack mission (essential for the low altitude, all weather combat capability of the F-16) was demonstrated. An effort to protect windscreens/canopies from laser radiation, a joint (Army, Navy, Air Force) effort to examine methods and define technologies to counter the emerging variable frequency laser threat (current countermeasures cannot protect against such threats), and an effort to protect advanced laser seekers such as the low level laser guided bomb (LLLGB) were initiated.

(2) (U) FY 1987 Program: Efforts to develop advanced protection against lasers for aircrew eye, LLLGB and canopies/windscreens will continue, and the hardened IR seeker for the Maverick missile will be demonstrated and validated. These efforts will concentrate on evaluating these newly hardened systems in an operational environment to ensure that laser protection does not degrade effectiveness. Efforts will be initiated to develop laser protection for reconnaissance optics and aircrew helmet mounted displays and sights.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: An effort will be initiated to develop

new materials and structures which are survivable under continuous wave and pulse lasers with application to tactical, strategic, and Air Force dedicated space systems. The effort to develop and demonstrate technology to protect canopies against lasers (which can suddenly frost and craze canopies, preventing the pilot from seeing) will be completed. Development of the advanced seeker Low Level Laser Guided Bomb technology will be completed and a demonstration effort will continue in order to protect the effectiveness of these vital precision guided munitions against enemy "spoofing efforts." An effort to develop materials technology for protection of aircrews from the crippling/blinding effects of variable frequency laser threats will be initiated. Efforts will be initiated to develop hardened advanced optical devices, such as optical limiters, narrow band filters, and switches. The proof of concept for this technology is being demonstrated in PE 62102F, Materials.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: A threat and vulnerability assessment addressing hardening of aircraft structures against continuous wave and pulse lasers will be initiated. The program developing variable frequency laser eye protection for aircrews will continue. An effort demonstrating the performance of laser hardened helmet-mounted displays and sights will be initiated. Scenarios and potential threats involving special operations aircrews are significantly different from those associated with tactical missions, therefore a program will be initiated to provide hardening goals, hardened materials and concepts for electro-optics and munitions for these aircrews. A technology demonstration program to protect sensitive reconnaissance optical systems against laser radiation will be initiated.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not applicable.

9. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 69CW, Advanced Composites

A. (U) Project Description: This project develops advanced nonmetallic structures technology including carbon-carbon, thermoplastic, ceramic/ceramic and advanced fiber reinforced nonmetallic matrices, and demonstrates the enhanced survivability, reduced weight, and improved cost and durability payoff of these structures for aircraft, missile, and Air Force dedicated space system applications. Further, validating advanced structures improves flight vehicle performance by offering enhanced capabilities. System survivability is greatly increased by developing structures to defeat projected nuclear, laser, and environmental threats. Radar absorbing materials and structures and integral structure infrared attenuation concepts will significantly reduce detection and tracking threats for advanced fighter aircraft.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Efforts performed in this project resulted in: completion of a flight test of highly supportable and survivable composites in the HH-60 Nighthawk rear fuselage; fabrication of six subcomponent test specimens to validate durability and damage tolerance repairability of the EF-111 horizontal stabilizer leading

edge; continuation of real flight time load/environmental testing of a fighter wing component to develop durability design and qualification procedures for composite structures; completion of full scale wing component tests to validate damage tolerance qualification requirements for composite structures; completion of detail design of a carbon-carbon two-dimensional sub-scale nozzle to be tested on the J85 engine; completion of tooling and fabrication of engine inlet duct components for low observable validation tests; and initiation of a repairability and maintainability effort to develop supportability procedures for radar absorbing materials and structures.

(2) (U) FY 1987 Program: Efforts planned for this project include: conducting the first-ever aircraft turbine engine test demonstration of a structural carbon-carbon two-dimensional (2D) nozzle, and completing the detailed design of carbon-carbon 2D vectored thrust nozzle structures for an advanced high performance fighter engine which will validate a 10 percent thrust to weight improvement as well as greater service life over metallic nozzle structures; completion of a full-scale wing component test of durability and damage tolerance for composite structures, and completion of ground and flight tests of graphite/thermoplastic A-10 wing trailing edge flaps to validate reduced maintenance costs relative to the baseline aluminum flap. The development of advanced radar absorbing materials and structures (RAM/RAS), including peacetime and combat supportability requirements/methods, and for application to advanced tactical fighter aircraft, will be continued. Several efforts will be initiated: a service test of an EF-111 horizontal stabilizer leading edge (constructed from graphite/bismaleimide) to demonstrate a 53 percent reduction in maintenance costs; demonstration of high temperature (2000°F) radar absorbing ceramic composite structures; development of high temperature (400°F) thermoplastic matrix composites to reduce fabrication costs and enhance supportability and damage tolerance of next generation fighter aircraft structures; development and validation of mission integrated canopies for application to advanced tactical aircraft; development of advanced high temperature (3000°F) carbon-carbon and ceramic composite structures and thermal control concepts for hypervelocity airframe applications; and development of a low observable, infrared attentuated structure for advanced fighters and missiles.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The composite structures efforts begun in previous years will continue during FY 1988. In the area of low observables, the technology will be developed and an order of magnitude reduction in radar cross section will be validated in the application of RAM/RAS to load bearing airframes for strategic and tactical aircraft. In a parallel effort the supportability of RAM/RAS will be addressed by developing inspection and repair techniques and procedures. Carbon-carbon 2D vectored thrust nozzles will be validated in an Aero Propulsion Laboratory engine component test. The test of the carbon-carbon nozzle structure developed in this project will show a 10 percent improvement in thrust-to-weight for high performance fighter aircraft engines. Carbon-carbon, ceramic structures and thermally resistant components will be developed for high temperature (2000°F) applications in hypervelocity and engines. The durability issues of the integrated transparency systems for fighter aircraft cockpits will be addressed in a development and validation effort.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Several long term composite structures efforts begun in previous years will be continued. These include: evaluation of thermally resistant components, validation of low cost, high performance RAM/RAS for advanced tactical fighter applications; demonstration of reduced weight and fabrication cost from application of ceramic composites to high temperature radar absorbing structures development of low observable infrared radar absorbing structures for aircraft and missile applications; and

development of supportable radar absorbing materials and structures for the advanced tactical fighter. In support of the application of carbon-carbon in the development of 2D nozzle structures, supportability requirements and procedures for repair and maintenance will be developed and validated.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not applicable.

10. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 486U, Advanced Metallic Structures

A. (U) Project Description: Advanced metallics are required to ensure that new aerospace systems are developed with increased performance at reduced cost. This project develops and demonstrates new metallic structures technology, including metal matrix composites (MMC) and powder metals which offer the potential for significantly reducing the weight and life cycle cost of future aircraft, aeropropulsion, missile, and space systems. Improved performance is offered by developing and demonstrating advanced metallic structures with higher temperature capabilities (for load carrying hot structures such as those required for hypersonic flight and jet engines). These structures will also be shown to have greater reliability/durability and enhanced resistance to natural and man-made hostile environments. This project supports the Joint Aero Propulsion Laboratory and Materials Laboratory High Performance Turbine Engine Technology initiative to provide the Air Force with technology base necessary for development of engines with double the propulsive capability.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Efforts performed in this project resulted in the fabrication, installation and flight demonstration of a set of aluminum/lithium wing skins for the F-15 short takeoff and landing technology demonstrator that resulted in an eight percent weight reduction. The in-service evaluation of seven center section leading edge flaps in Air National Guard A-7 aircraft was completed and, at the request of the Air Guard, those components have remained in service. The improved leading edge flaps demonstrated the use of damping technology to increase design life from 1400 hours to 80,000 hours (based on full scale accelerated tests), with only a four percent (1 lb) weight increase and a three percent cost increase while support costs declined 80 percent. The in-service evaluation of six F-111 spoilers on USAF aircraft was completed. These components demonstrated a 70 times increase in durability resulting in a cost savings of $5 Million in maintenance costs over a 10 year period. The new A-7 leading edge flaps and F-111 spoilers have been selected by the Air Force Logistics Command for production as preferred spares. Built-up titanium technology was transitioned to F-15E production. Fabrication was completed on two F-15 MMC horizontal tails to be flight tested by the Air Force Logistics Command. Fabrication was completed on a prototype titanium reinforced MMC engine blade which offers a significant decrease in specific fuel consumption. New development of aluminum-lithium and high strength aluminum fighter structures will be continued.

(2) (U) FY 1987 Program: Efforts to be undertaken in this project include the fabrication of a complete set of titanium-reinforced metal matrix composites (MMC) engine blades and testing of engine and foreign object damage. Air Force Logistics Command concerns regarding the supportability implications of hybrid structures (organic composite surfaces and metallic substructures) will be investigated in an aircraft fuselage component demonstration program. The goal is to reduce maintenance support costs by 70 percent. Qualification tests and flight tests of F-15 MMC horizontal stabilizers will be conducted. A high temperature aluminum demonstration program will be initiated to demonstrate a 50 percent reduction in the cost by replacing titanium with aluminum structures capable of operating at 600°F. A titanium MMC program will demonstrate a 50 percent weight reduction in turbojet engine rotor disks. A program combining MMC and viscoelastic damping will demonstrate a 30 percent weight reduction in large space structures. Fabrication of the large aluminum MMC vertical stabilizers should demonstrate a 30 percent weight savings and a 50 percent cost reduction. A program will be initiated using the damping technology demonstrated in previous years will be used to eliminate the high in-service failure rate of the A-10 aircraft inlet extension ring.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The advanced aluminum fighter structure program will be completed with the structural verification testing of aluminum lithium and powder metallurgy aluminum fuselage components. The result will be a conclusive demonstration of a 15 percent weight savings in Advanced Tactical Fighter (ATF)-type structures. The elevated temperature aluminum program will be continued. The objective of this effort is to replace titanium with aluminum in structures operating in the temperature range of 300°F to 600°F at a 15 percent weight and a 50 percent cost reduction. The supportable hybrid fighter structures program will address the supportability and survivability requirements of critical structure features of the ATF. Two test articles will be fabricated to demonstrate repair, maintenance, durability, and damage tolerance of hybrid (metallic and composite) fuselage sections. The viscoelastic damping technology demonstrated in previous efforts will be applied to large space structures for improved dynamic behavior at a 30 percent weight reduction. The structure verification testing of the large MMC vertical stabilizers will continue. The effort will conclusively demonstrate a 10 percent weight savings and a 25 percent acquisition cost reduction.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The structural verification testing of the large aluminum MMC vertical stabilizers will be completed. Component fabrication for the elevated temperature aluminum program will be initiated. Validation testing of the hybrid supportable structures program will be initiated. The MMC disks will be fabricated for the Composite Disk Validation effort. The disks will demonstrate a 50 percent weight reduction in turbojet engine disks for application in the High Performance Turbine Engine Technology Initiative. The program to harden aircraft structures against projected battlefield laser threats will be continued. Efforts to develop and validate metallic structures for advanced hypervelocity airframes at operating temperatures to 3000°F will be initiated. These high temperature structures, fabricated from heat resistant rapid solidification technology titanium and nickel-based superalloys in conjunction with active cooling techniques, will be tested in a high temperature environment. Fabrication will be initiated on a component to demonstrate structural damping. This technology has application in reducing the adverse effects in the high acoustic environment assoicated with equipment and weapons bays.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not applicable.

II. (U) COOPERATIVE AGREEMENTS: Not applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63216F
DOD Mission Area: 553 - Engineering Technology (ATD)

Title: Aerospace Propulsion and Power Technology
Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		31,663	28,884	33,719	37,823	Continuing	N/A
2480	Aviation Turbine Fuel Technology	6,181	1,737	1,589	0	0	38,700
2697	Atmospheric Propulsion Concepts		1,020	2,940	5,949	Continuing	N/A
3035	Aircraft Power Systems	392	1,410	3,240	3,250	Continuing	N/A
3036	Missile Systems Power	0	50	600	1,200	Continuing	N/A
681B	Advanced Turbine Engine Gas Generator (ATEGG)	25,090	24,667	25,350	27,424	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: In response to the Congressional interest to reduce the number of program elements, this program element is the result of a combination of three program elements; 63215F, Aerospace Fuels and Propulsion Technology; 63216F, Advanced Turbine Engine Gas Generator (ATEGG); and 63217F, Weapon Systems Power. Prior to the next budget submission the projects will be reduced to four to emphasize the broad categories of technology being pursued, turbine engine gas generators, power systems, fuels, and airbreathing propulsion technology. The efforts conducted under this program element ensure a continuous development and demonstration of the most advanced turbine engine high pressure core components, advanced airbreathing concepts such as variable flow ducted ramjets, air-turboramjets and combined cycle engines, the fuels for turbine engines and advanced airbreathing concepts, and advanced power technology for all Air Force aerospace vehicles. Technology demonstration in these areas enhances low risk transition of these technologies to engineering development. By testing and assessing performance, durability, and reliability characteristics, advanced Air Force vehicles will be able to achieve longer range, higher payload, increased maneuverability, increased probability of kill, increased survivability, and improved operability. Anticipated technology advances from this program include 35-60% reduction in aircraft takeoff gross weight and more than 100% range increase compared to Advanced Tactical Fighter requirements, two to four times range and increased average missile velocity for tactical air launched missiles, new fuel options to support advanced hypersonic vehicles flying three to six times the speed of sound, advanced aircraft power providing 8000 pounds per square inch nonflammable hydraulic system, and advanced thermal batteries for munitions which eliminates the need to replace batteries during munition lifetime. This is a Science and Technology effort.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E 63216F	26,933	27,838	26,999	N/A	Continuing	N/A

EXPLANATION: (U) Funding increases are a result of combining the efforts and resources of PE 63215F, PE 63216F, and PE 63217F. This was done to reduce the number of Air Force Science and Technology program elements.

4. (U) OTHER APPROPRIATION FUNDS: Not applicable.

5. (U) RELATED ACTIVITIES: Technology feasibility and practicality are demonstrated initially in exploratory development under PE 62203F, Aerospace Propulsion. The turbine engine subsystems such as controls, fans, fan drive turbines and afterburners which, when added to the basic gas generator complete the engine, are demonstrated in advanced development under PE 63202F, Aircraft Propulsion Subsystems Integration. Close coordination will be continued with the Navy; Army; National Aeronautics and Space Administration (NASA); Interagency Advanced Power Group; Joint Army, Navy, NASA, Air Force (JANNAF) Interagency Propulsion Committee to ensure that resources are effectively utilized for common needs. Current and planned development efforts by the Navy Advanced Propulsion Program (PE 63210N), the Aircraft Propulsion Subsystem Integration Program (PE 63202F), Turbine Fuel Technology Program (PE 63215F), Materials Laboratory (PE 62102F), Manufacturing Technology (78011F), and Aerospace Structures and Materials (PE 63211F) directly complement Project 681B effort. In addition to these standing efforts, the Aero Propulsion Laboratory together with the Materials Laboratory has started a new initiative directed toward creating, during the FY 1990's time frame, the component technologies that will cause revolutionary changes in Advanced Turbine Engine Gas Generator (ATEGG) technologies through FY 2010. This new initiative is called the High Performance Turbine Engine Technologies (HPTET) initiative and will focus joint resources to advance aerodynamics, materials, and the innovative design capability such that a minimum weight, high power core technology can be achieved in the ATEGG program, that offers improvements of at least 100% over the Advanced Tactical Fighter Engine technology. Starting in FY 1988, this effort will become a part of the DOD Integration High Performance Turbine Engine Technologies Initiative. Project 2480 supports fuel assessments conducted in the Air Force's Operational Validation Program, PE 71112F. Project 2697 provides airbreathing propulsion options for the Advanced Missile Technology Integration, PE 63363F, Project 3254. Test fuel acquisition transportation and storage is managed by the Defense Fuel Supply Center of the Defense Logistics Agencies.

6. (U) WORK PERFORMED BY: The program is managed by the Aero Propulsion Laboratory, Wright-Patterson Air Force Base, OH. The top five contractors currently involved in this effort are: Teledyne CAE, Toledo, OH; General Electric, Evendale, OH; Pratt and Whitney, West Palm Beach, FL; Garrett Turbine Engine Co, Phoenix, AZ; and Boeing Military Airplane Co, Seattle, WA. There are three other contractors involved with contracts totalling $13.5 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 2480, Aviation Turbine Fuel Technology. This program develops a less restrictive specification for aviation turbine fuels. These new specifications allow refiners to expand the types of feedstocks they may use for making these fuels to include lower quality petroleum, tar sands, high density oils, and coal liquids. This will increase the availability of fuel which is especially important in times of national crises and also reduces the purchasing cost during normal resupply. An additional benefit of the new specification is an increase in the volumetric heat of combustion, enabling a 10 to 15 percent increase in range for volume limited aircraft. FY 1986 Program: The experimental and analytical investigation to determine the cost, yield and properties of jet fuel produced from tar sands and heavy oils is being completed. Studies to assess the future availability and the properties of high density

jet fuels, as well as test programs to assess the impact of the use of high density, high volumetric energy fuels on operational USAF engine combustor systems, have continued. The FY 1986 Appropriations Bill directed an evaluation of fuel produced from coal, a program is being initiated to assess coal derived fuel characteristics and determine the adverse effect of coal derived fuel usage in aircraft systems. The qualification of coal derived JP-4/JP-8 fuel is a major effort. FY 1987 Planned Program: The qualification of coal derived jet fuel will continue. The assessment of future availability, and the determination of the characteristics of jet fuels produced from higher density feedstocks will be completed. The test and evaluation programs to determine the impact of high density fuel on performance and durability of aircraft combustor systems will be completed. Testing will be initiated to assess operability and performance impacts of this fuel in aircraft fuel systems. Candidate first generation endothermic fuels, which can potentially provide a large heat sink capability for hypersonic aircraft, will be evaluated. FY 1988 Planned Program: Heat sink capabilities of first generation candidate endothermic fuels such as methylcylohexane will be determined. The development of these fuels for hypersonic vehicle applications supports Project Forecast II's "Combined Cycle Engine" technology. FY 1988 is the last projected year for RDT&E funding.

B. (U) Project: 2697, Atmospheric Propulsion Concepts. This project will develop and integrate the engine components (inlet, gas generator/valve, booster, ramburner) required to realize a variable flow ducted ramjet (VFDR) engine using a solid hydrocarbon fuel. Engine performance will be extensively evaluated and documented through a ground test program which includes environmental and freejet wind tunnel tests. The end product is a flight weight engine ready for flight test and/or full-scale development. Upon completion of the ground test effort, delivery of flight test engines will be made and a flight evaluation will be conducted under Project 3254, Advanced Missile Technology Integration (AMTI) in PE 63363F. Initiation of this program in FY 1987 will provide the Air Force with advanced missile propulsion capability in the 1990s to meet the expanding threat, such as a Soviet equivalent to the Advanced Medium Range Air-to-Air Missile. Initial engine design and performance requirements will be established. Changes and/or improvements required in components previously investigated in exploratory development will be determine and initiated. In FY 1988 the VFDR effort will continue with the development of airframe/propulsion interface specification. The design, structural analysis, and specifications for an inlet/aero test will be accomplished. Component development for the gas generator/valve, booster, and port cover will proceed along with preliminary ramburn performance tests which incorporate initial integrated design features. The previous component and ramburner tests will provide guidance for accomplishing direct connect ramburner performance verification tests in FY 1989-1990 Also in FY 1989, inlet/ aero testing will be accomplished along with the final engine design. Inlet cover and port cover testing will be completed in conjunction with the initiation of environmental testing in FY 1990. The program will complete development through environmental flightweight engine tests, and accomplish final performance verification in freejet ground tests. The final freejet engine tests in April 1991 will demonstrate a flight weight engine ready for full-scale development or a product improvement program.

C. (U) Project: 3035, Aircraft Power Systems. This project is currently developing and demonstrating a high pressure nonflammable hydraulic power system for advanced tactical and strategic aircraft, applicable to all future aircraft. Demonstration of this compact hydraulic system using nonflammable fluid and operating up to 8000 pounds per square inch absolute (psia), will facilitate the application of low internal volume, thin wing technology, and provide significant weight savings for next generation fighters. In FY 1986 development began for an 8000 psia nonflammable

hydraulic system demonstration. FY 1987 efforts include the design of the 8000 pounds per square inch (psi) hydraulic system. Design, fabrication, and test of critical system components (nozzle and control surface actuator, compatible seals, and force motors to replace hydraulic pumps), along with design and fabrication of the prototype system for ground testing, will also be accomplished. The design will pay specific attention to reliability and maintainability issues, as well as to performance considerations. Preliminary concepts promise simplified hydraulic systems, weight savings, and elimination of the hydraulic fluid related fire hazard. FY 1988 goals include complete fabrication of the ground demonstrator and initiation of testing which will provide essential system level design data to allow technology transition to the Advanced Tactical Fighter by the end of FY 1989. Development of improved aircraft engine starter technology for low temperature, multiple starts will be initiated in FY 1988. This technology will reduce the need for aerospace ground equipment, increase aircraft autonomy. Development of an aircraft integrated power system will be initiated in FY 1989 and will combine results from the fault tolerant electrical power system, aircraft battery state-of-charge and Very High Speed Integrated Circuits (VHSIC) insertion exploratory programs in PE 62203F into an integrated aircraft electrical power system demonstrator for improved survivability, reliability, and weight/volume savings. These project efforts are aircraft related and do not duplicate any Strategic Defense Initiative work.

D. (U) Project: 3036, Missile Systems Power. Power source technology required by advanced tactical and strategic missile weaponry will be developed. The objective is this project provides new lithium thermal battery technology for advanced tactical missiles where longer guide range is required. Outyear developments will provide enabling power source technology for electrically propelled tactical drone applications and advanced lightweight, high performance reserve batteries for advanced Intercontinental Ballistic Missile on-board power. Development of a low cost, no maintenance battery for tactical missiles will begin in FY 1987. FY 1988 goals include fabrication and testing of the improved battery as a more cost effective, long storage life replacement for short storage life silver-based batteries in a variety of tactical missiles/munitions. In FY 1989, design verification testing will be concluded with technology to operational systems promises significant life cycle savings through reduced maintenance and refurbishment for numerous tactical applications. This project is missile related and does not duplicate any Strategic Defense Initiative work.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 681B, Advanced Turbine Engine Gas Generator (ATEGG)

A. (U) Project Description: This Advanced Development Program will ensure that turbine gas generator technology is available to meet the requirements of future aircraft propulsion systems. To ensure that these needs can be met requires a better definition of the engine's operating environment; advanced designs that maximize the trade-offs between performance and life characteristics within this environment; and effective test and measurement techniques to verify this capability. The gas generator is the basic building block of the engine and it consists of a compressor, a combustor, and a high pressure turbine which powers the compressor. The objective of this program is to provide the continued evolution of the most advanced core engine technologies (compressors, combustors, and turbines) into an

advanced gas generator in which the performance, cost and durability aspects can be assessed in a real engine environment. This critical hardware demonstration will enhance the early low risk transition of these technologies into engineering development where they can be applied to growth systems and/or new systems. The technologies are scalable, flexible, and applicable to a large range of potential systems applications. Flight size, flight weight gas generators are initially tested to define flow path characteristics. Once the flow path has been characterized and mechanical integrity verified, the gas generators are subjected to accelerated life testing to characterize the structural aspects of the advanced component designs. New component technologies are introduced on a step-by-step basis so their individual performance/structural characteristics can be assessed and the relationship (effect) of the new component on other components and the integrated gas generator can be accurately assessed.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: New flow-path designs of the latest propulsion core technologies have been evaluated, approved and extensive effort is underway to manufacture, instrument and assemble the technologies into core engine configurations prior to testing. In the Advanced Turbine Gas Generator (ATEGG) efforts, technologies to be assessed included a new generation high-through-flow compressor which offers a 50% to 80% parts reduction, advanced single and dual-wall combustor designs which offer four times improvement in life capability, advanced film cooled turbine vane and blade technology for the high pressure turbine utilizing advanced monocrystal alloys with three times life capability, and incorporation of variable geometry features in all major components to improve life and performance including transient response and cycle flexibilty. Additionally, key technologies necessary for the Advanced Tactical Fighter Engine (ATFE) to be developed at acceptable risk were run in the ATEGG cores in "pre-ATFE" configurations to gain insight into the specific unknowns of the technologies. The severity of the Advanced Turbine Engine Gas Generator ATEGG tests is much greater than those anticipated for the Advanced Tactical Fighter. This information, gathered on advanced design concepts, new materials, and component synergistic compatibility will provide insight into the reality of the ATFE expectations.

(2) (U) FY 1987 Program: ATEGG is a continuing program which evaluates the most promising and the highest risk - highest payoff advanced gas generator components and design concepts in an actual engine environment. In the FY 1987 time period, all ATEGG contractors will be conducting extensive environmental characterization testing as well as some accelerated life and durability testing of the latest component technologies which will have just completed initial flow-path/performance assessment in the FY 1986 test series. These efforts will provide increased confidence in the transitioning of advanced technology options which offer a three to four times improvement in life, 30% to 50% increase in specific core power energy levels, 50% to 80% reduction in number of parts, and 20% to 30% reduction in life cycle cost. These values of expected performance are compared to the ATFE for a baseline. Additionally, during this time period, there are new starts planned that will provide for the extensive incorporation of the newest technology concepts generated from the High Performance Turbine Engine Technologies (HPTET) initiative. The new Exploratory Development Initiative technologies will be designed into the ATEGG components and core demonstrators tested as soon as technically feasible. The funding required for FY 1987 is necessary in order to incrementally fund multi-year contracts initiated in FY 1985 and fund the new starts. All FY 1985 contracts are firm-fixed-price and the new start FY 1987 contracts will be cost type.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The FY 1988 program will be a continuation of the contracts that are awarded in FY 1987 from the FY 1986 new starts. In this time period, innovative component technologies that have matured through the High Performance Turbine Engine Technologies (HPTET) initiative will be going through a final design review and manufacturing process in preparation for testing. These technologies will be the first of the HPTET initiative and represent the first step toward achieving the turn of the century capability and offer diverse propulsion options and alternatives for the broad spectrum of systems characterized in Forecast II. These Air Force efforts form part of the DoD Integrated High Performance Turbine Engine Technologies. The technologies themselves will be 25% to 30% of the weight reduction, 50% of the core power values, 50% of the durability values, and 50% of the specific fuel consumption goals expected for the turn of the century engine. During this time period as in all of the late 1980's and entire 1990's, ATEGG will be the high risk-high payoff demonstrator test bed for the most innovative and most promising Air Force propulsion technologies. The cost estimate is Category IV, Planning.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Final testing of the innovative concepts that were manufactured and assembled in the prior two years will be tested for full design capability. The final goals of the FY 1988 program will be realized and final test data assessed for its completeness and accuracy. In addition, a new three year program will be initiated to further develop the High Performance Turbine Engine Technologies, necessary technologies, and refine propulsion options and alternatives for the broad spectrum of technologies necessary for Forecast II systems. These new technologies will be 30% to 40% of the weight reduction, 65% to 70% of the core power values and 60% of the specific fuel consumption goals expected for the turn of the century engines.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones:

Milestones		Dates
(1) Advanced Alloy/Cooling Turbine Concepts	*(September 1985)	June 1986
(2) Complete High-Through-Flow Durability Tests		September 1986
(3) Initial Innovative Component Concepts Application		September 1987
(4) Major Core Power Increase Initial Demonstration		September 1988
(5) Initial Non-Metal Rotor Application		September 1989
(6) First High Performance Turbine Engine Full Core Demonstration		September 1990
(7) First Combined High Performance Turbine Engine Components Centerline Design		September 1991
(8) First Combined High Performance Turbine Engine Core Technologies to Test		September 1992

* Date presented in FY 1987 Descriptive Summary.

(U) Explanation of Milestone Changes

(1) Slip due to airfoil casting problems.

9. (U) COOPERATIVE AGREEMENTS: Not applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63226F
DOD Mission Area: 551 - Electronic and Physical Sciences (ATD)

Title: DOD Common Programming Language (Ada)
Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	6,852	6,727	15,673	20,552	Continuing	N/A
2853	DOD Common Programming Language (Ada)	6,852	6,727	6,503	6,743	Continuing	N/A
3593	Ada Technology Insertion	0	0	9,170	13,809	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program is a Science and Technology effort and is part of the total DOD effort to introduce and implement life-cycle support for Ada, the DOD common high-order programming language for mission-critical computers. It provides resources to meet those language support requirements which are common to the various services and agencies. It provides for configuration control of the Ada language, enforcement of standardization via compiler validation, education/promotion, and development of Ada Programming Support Environment (APSE) technologies. APSE technologies include the standardization of environment interfaces, interface validation, and tool and technique development for performance evaluation of environments. Further, this program provides incentives for accelerated insertion of Ada into weapons systems programs through sharing of cost and other risks associated with transitioning from other languages and technologies.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	7,270	6,890	6,503	N/A	Continuing	N/A

EXPLANATION: (U) The funding increase in FY 1988 is in response to a Defense Science Board recommendation to offset risks associated with inserting Ada into programs.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable

5. (U) RELATED ACTIVITIES: The Ada program is managed by the DOD Ada Joint Program Office (AJPO) in coordination with the DOD components. The AJPO oversees the common Ada-related needs of the DOD, and the components are responsible for component specific needs. Each component is responsible for developing an implementation strategy and executing it. Related program elements supporting component specific Ada needs are: PE 64740F, Computer Resources Management Technology; PE 63728F, Advanced Computer Technology; PE 63723A, Command and Control; PE 62746A, Tactical Automated Data

Processing Technology; and PE 63526N, Advanced Computer Technology. In addition to the above, work performed under this program element (PE 63226F) is the basis for some ongoing efforts under PE 63752F, DOD Software Engineering Institute and PE 63756A, Software Technology for Adaptable/Reliable Systems (STARS).

6. (U) WORK PERFORMED BY: The Ada Joint Program Office (AJPO) is responsible for all work performed under this program element. Specific efforts are conducted by Air Force, Army, and Navy organizations as appropriate. Major contractors are Institute for Defense Analyses, Alexandria, VA; Softech, Waltham, MA; Illinois Institute of Technology Research, Chicago, IL; The Analytical Sciences Corporation (TASC), Reading, MA, and MITRE Corporation, Bedford, MA. At various times there are an additional 5 to 25 contractors performing on contracts that are funded in part or wholly under this program element.

7. (U) PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2853, DOD Common Programming Language (Ada). DOD computer software life-cycle costs are measured in the billions of dollars. Transition to this single, modern, high-order language in defense systems will derive significant benefits for DOD in the areas of training, compiler and programming tool availability, software maintainability and reduction of other software development costs. Under this project the AJPO will: (1) ensure the implementation and maintenance of Ada as a consistent unambiguous standard recognized by the DOD and also by the widest possible community; (2) ensure the smooth introduction and acceptance of Ada in the DOD as early as possible and consistent with the needs of individual components. In FY 1986 this project: completed the fourth version of the Catalog of Resources for Education in Ada and Software Engineering; increased the number of validated Ada compilers to a total of 64; finalized formal proposal of the Common APSE (Ada Programming Support Environment) Interface Set (CAIS) as a DOD-STD document; updated and distributed the Ada Compiler Validation Capability (ACVC) test suite; completed a prototype Ada compiler benchmarking system; completed a description of design rationale for the Ada language; and conducted the first Annual Ada Software Engineering Education Team (ASEET) Symposium for Ada insertion into university curricula. In FY 1987 this project will: complete the establishment of Ada as an International Standards Organization (ISO) standard; continue to support the technology to enhance Ada compiler validation through the development of automated validation tools; continue efforts on DOD-STD-CAIS; enhance the ACVC by additions to the test suite; continue operation of the Ada Information Clearinghouse; pursue a joint effort with NATO to develop CAIS based enhanced Ada support environments; continue the compiler evaluation program; develop guidelines for the use of Ada Run-Time Environment Systems; and report the results of study of the Ada education and training requirements and capabilities within industry, DOD and NATO. In FY 1988 this project will: continue to support the international efforts to develop a formal definition of the Ada language; maintain support for ongoing configuration control of the standard and the Ada Board efforts; enhance procedures for the coordination of world-wide Ada Validation Facility tools and procedures; complete the development of an Ada Compiler Evaluation Capability; support NATO work in APSE interface set technology; complete video software engineering courses for software engineers, as well as mid and high level managers; promote efforts to foster the sharing of Ada program packages and continue to develop quality military education and training in Ada; enhance the Ada Compiler Validation facility; begin final efforts to get approval for the revision to the DOD-STD-CAIS; and develop an Ada Support Environment evaluation capability for use in selection of

such environments by system program offices. Cost estimates for fiscal 1988 efforts are planning in nature (category IV) based on program office preliminary analysis of similar efforts or extrapolation of current actual costs that are relevant to expected fiscal 1988 tasks. These cost estimates were last revised in September 1986. In FY 1989 the project will: continue support to the Ada Board; analyze and respond to inputs from the international community on proposed revisions to the Ada standard; develop procedures for the coordination of world-wide Ada Validation Facility tools and procedures; maintain the Ada Compiler Evaluation Capability; continue the effort to foster the sharing of Ada program packages; continue development of quality military education and training in Ada; continue to support improvement to the Ada Compiler Validation Capability (ACVC); continue development of an Ada Support Environment evaluation capability; and continue development of a validation capability for the Common APSE (Ada Programming Support Environment) Interface Set (CAIS) in order to enforce the CAIS standard. Cost estimates for fiscal 1989 effort are planning in nature (category IV) based on program office preliminary analysis of similar efforts or extrapolation of current actual costs that are relevant to expected fiscal 1989 tasks. These cost estimates were last revised in September 1986.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3593, Ada Technology Insertion

A. (U) Project Description: This new start in FY 1988 will provide risk reduction for Ada Insertion. Ada is considered a high risk approach when applied to such areas as, but not limited to, multilevel security, advanced architecture, distributed processing, and generation of high performance object code. In addition, unprogrammed costs and risks exist in a number of programs which did not initially plan for, but could now reasonably convert to Ada. Cost and risk sharing incentives will be established to reduce the initial impact of acquiring Ada compilers, tools, education, and associated items and apply them to new and major upgrades to weapons system programs. Criteria will be established for selection of programs based on expected overall long term benefits. The project will address all DOD component projects currently developing products in areas such as Simulation, Avionics, Fire Control, Missiles, and Command, Control, Communications, and Intelligence (C^3I), Electronic Warfare, Undersea Warfare, and Land Warfare. The project will accelerate the incorporation of Ada and therefore develop a broader Ada technological base for DOD components. In addition, productivity data will be collected on each participating program if the collection is determined to be cost effective.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Not Applicable

(2) (U) FY 1987 Program: Not Applicable

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Criteria and procedures will be developed for processing and evaluating proposals from weapons system programs for participation in this Ada risk

sharing effort. A list of candidate programs in priority order will be developed. This new start will request all DOD components to propose candidate programs, both projected and ongoing, in laboratory, full scale development, or production phases for funding. Emphasis on selected programs will be on the life cycle cost benefits of the candidate. After review, candidates will be selected and funding will be apportioned to accomplish goals. This review cycle will continue yearly. Cost estimates for fiscal 1988 effort are planning in nature (category IV) based on program office preliminary analysis of similar efforts or extrapolation of current actual cost data that are relevant to expected fiscal 1988 tasks. These estimates were last revised in September 1986.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The project will review progress on selected programs already funded. The selection criteria will be reviewed and reevaluated, new starts will be selected from DOD-component candidates and will be appropriately funded. Programs are unranked at this time to allow DOD components to propose candidates in FY 1987. Demonstration of technology breakthroughs will be conducted. Cost estimates for fiscal 1989 effort are unranked in nature (category V) based on program office analysis of current candidate programs.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones:

Milestones	Dates
(1) (U) Establish criteria and procedures	October 1987
(2) (U) Initiate funding for selected projects	December 1987
(3) (U) Review and evaluate new candidate programs for FY 1989	June 1988
(4) (U) Initiate new program starts	October 1988
(5) (U) Review and evaluate new candidate programs for FY 1990	June 1989
(6) (U) Initiate new program starts	October 1989

9. (U) COOPERATIVE AGREEMENTS: Not applicable

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63227F　　Title: Personnel, Training, and Simulation Technology
DOD Mission Area: 552 - Environmental and Life Sciences (ATD)　　Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual #	FY 1987 Estimate #	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	8,021	7,475	10,902	12,743	Continuing	N/A
* 2362	Computer Based Maintenance Aids for Technicians	424	0	0	0	0	4,934
2363	Advanced Visual Technology System	2,802	1,385	2,215	3,038	Continuing	N/A
2364	Training and Performance Data Center	927	400	380	490	Continuing	N/A
* 2557	Advanced On-the-Job Training System	1,874	1,848	2,101	1,225	0	10,613
2743	Aircrew Combat Mission Enhancement	180	2,371	4,526	3,939	Continuing	N/A
**2922	Personnel Assessment Systems	1,054	780	833	1,289	Continuing	N/A
**2949	Basic Job Skills Assessment and Enhancement***	710	530	615	923	Continuing	N/A
**2951	Training Decisions System	50	150	200	300	548	1,525
* 3056	Air Combat Assessment and Debriefing System	0	011	32	1,539	12,702	16,348

\# Consolidation of formerly separate, but related, Program Elements has been accomplished to meet Congressional Direction to reduce the number of Program Elements. Prior years reflect FY 1988 Science and Technology restructure for comparability purposes only.

* Projects 2362, 2557, 3056, and 3057 were documented for FY 1987 and prior years under Program Element 63751F.
** Projects 2922, 2949, and 2951 were documented for FY 1987 and prior years under Program Element 63704F.
*** Efforts documented for FY 1987 and prior years under Project 2948, Occupational Analysis Program, are now included in Project 2949.

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Science and Technology Program funds advanced development to increase the Air Force's readiness and effectiveness by providing cost-effective solutions to problems of training, personnel acquisition and job assignment, manpower management, and human performance in weapon systems. It includes efforts to develop: technologies for selecting, classifying, and assigning quality men and women for Air Force jobs; advanced technical training systems to increase the efficiency and productivity of Air Force personnel; technologies to

estimate manpower, personnel and training requirements for weapon system design trade-off decisions and to enhance supportability of new weapon systems, and technologies to improve aircrew combat skills training. Also included in this program element is the Air Force portion of funding for the Tri-Service Defense Training and Performance Data Center in Orlando, Florida. This program responds to Congressional and Department of Defense mandates to update and validate tests that screen and classify military recruits, including the advanced development of the Armed Services Vocational Aptitude Battery, the selection and classification instrument for all enlisted applicants for US Armed Forces. Development and validation of these tests will lead to more accurate selection and classification of individuals and ensure an improved match of individual aptitudes and job requirements. Increased complexity of AF systems and rapidly changing technology requires development and application of advanced training system technologies for maintenance and support personnel to ensure success in combat operations. Efforts will focus upon applications of computers and artificial intelligence to training, performance measurement and job aiding, including development of intelligent computer-assisted training and low cost stand-alone training devices to support tactical, strategic, and space-related missions. A special emphasis of this program is to develop and demonstrate improved flight simulator visual image generation and visual display technologies in order to provide more adequate visual scenes for combat mission training, a low cost, highly transportable, combat mission trainer for use at squadron level, and the technology to link numerous trainers at dispersed locations, to enable realistic, large-scale, joint service combat training exercises. Technology development efforts also support in-aircraft combat training through the development of an air combat assessment and debriefing system, similar to that provided at the instrumented combat ranges, which will provide significant improvements in home base pilot training and performance.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
RDT&E Program Element 63227F	4,297	5,054	6,409	N/A	Continuing	N/A
RDT&E Program Element 63704F	2,143	2,370	2,491	N/A	Continuing	N/A
RDT&E Program Element 63751F	2,264	2,411	2,432	N/A	Continuing	N/A
Total RDT&E	8,704	9,835	11,332	N/A	Continuing	N/A

* Includes $250 thousand for Project 3057.

EXPLANATION: (U) This consolidated Program Element 63227F now consists of funding for all projects formerly documented in Program Elements 63227F, 63704F, and 63751F, except Project 3057 from Program Element 63751F which, through administrative error, has not yet been transferred. The reduction in FY 1987 was due to Congressional action.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Military Construction: Funds	0	4,900	0	0	0	4,900

5. (U) RELATED ACTIVITIES: Related program elements: 61102F, Defense Research Sciences; 62201F, Aerospace Flight Dynamics; 62202F, Aerospace Biotechnology; 62204F, Aerospace Avionics; 62205F, Personnel, Training, and Simulation; 63253F, Advance Integration Avionics; 63259F, Cartographic Applications; 63751F, Training Systems Technology; 64227F, Flight Simulator Development; 62717A, Human Performance Effectiveness and Simulation; 63216A, Synthetic Flight Simulators; 63731A, Manpower and Personnel; 63738A, Non-Systems Device Development; 62757N, Human Factors and Simulation Technology; 62763N, Personnel and Training Technology; 63707N, Manpower Control System Development; 63720N, Education and Training; and 63733N, Training Device Technology. Air Force efforts directed toward improvement of the Armed Services Vocational Aptitude Battery and the production of new forms of that test are directed, in part, by a tri-Service steering committee of General Officers. Similarly, efforts concerned with the development of computerized testing techniques, for eventual implementation at Military Enlistment Processing Stations, are coordinated with the other Services. Air Force responsibilities lie principally in the development of test items suitable for computer implementation. Efforts across all Services to develop job performance measures are coordinated by a working group monitored by the Office of the Assistant Secretary of Defense for Force, Management and Personnel. Close coordination is maintained both at the working level and by laboratory management with other Services. Exchange of proposed statements of work for contractual efforts, wide dissemination of technical reports, and attendance at symposia and meetings ensure that work conducted within this program element benefits from and does not duplicate work conducted by the other Service laboratories. There is a continuing interface and close coordination among the Army, Navy, and Air Force on training simulation. The Air Force Human Resources Laboratory closely monitors all significant research and development being conducted by other Department of Defense, National Aeronautics and Space Administration, and industrial organizations in order to prevent duplication of effort. Close coordination within the Air Force user community is also accomplished by annual research and development coordination meetings between the Laboratories, the Aeronautical Systems Division, and the Major Commands.

6. (U) WORK PERFORMED BY: This program is managed by three divisions of the Air Force Human Resources Laboratory: The Manpower and Personnel Division, Brooks AFB, TX; the Operations Training Division, Williams AFB, AZ; and the Training Systems Division, Brooks AFB, TX. The Operations Training Division has an operating location at Davis-Monthan AFB, AZ, in support of Project 3056, and the Training Systems Division has an operating location at Bergstrom AFB, TX, in support of Project 2557. The major contractors are: Singer Company, Binghamton, NY (Projects 2363 and 2743); General Electric Company, Daytona Beach, FL (Projects 2363 and 2743); University of Dayton, Dayton, OH (Projects 2363 and 2743); Canadian Commercial Corp, Ottawa, Canada (Projects 2363 and 2743); and McDonnell Douglas, St Louis, MO (2557). There are four additional contractors with contracts totalling $2.5 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 2363, Advanced Visual Technology System (AVTS). This project develops technology to advance the state-of-the-art in visual simulation technology and demonstrate the utility of this technology for critical Tactical Air Force training requirements. From 1981 to 1986, this project has produced: this country's most advanced computer image generator for flight simulation, which includes an advanced texturing capability that significantly increases scene detail, complexity and realism; a prototype Fiber-Optics Helmet-Mounted Display, which uses lightweight optics to present the computer-generated image on glass plates directly in front of the pilot's eyes; and a 24-foot-diameter limited field-of-view dome visual display system. The advanced visual technology system image generator and the Fiber-Optics Helmet-Mounted Display have been transferred to Project 2743, Aircrew Combat Mission Enhancement (ACME), for integration into the ACME testbed complex. In FY 1987, the limited field-of-view dome display system will be equipped with an F-16A cockpit to produce a flight simulator for evaluating the training effectiveness of current technology. Training effectiveness issues to be investigated in FY 1987 thru FY 1989 are: simulator fidelity questions (such as the required field-of-view, display resolution, image brightness and image contrast), image generator scene content, gaming area data base accuracy requirements, target model fidelity requirements, and the most effective use of color in flight simulator training. In FY 1987, a major new hardware effort be the development of the next generation full field-of-view dome visual display system, a $10 million, three year project, jointly funded by the Aeronautical Systems Division (Project 2325, PE 64227F). Current full field-of-view dome displays suffer from limited resolution and brightness and use target tracked insets (a small, higher resolution area centered on the target which moves as the target moves) and are limited to simulation of air-to-air combat. The object of this new development is to exploit current head- and eye-tracking techniques to project a high resolution area of interest inset wherever the pilot is looking within the dome. This will provide high detail scenes to the pilot which are suitable for both air-to-air and air-to-ground combat simulation, without generating false cues to target location, as occurs with target tracking insets. Installation and integration of the dome will be completed by FY 1989, with training effectiveness evaluations beginning in FY 1990.

B. (U) Project: 2364, Training and Performance Data Center. This project provides the annual Air Force portion of the funding for the tri-Service, Defense Training and Performance Data Center (TPDC), formerly Defense Training Data and Analysis Center, established in FY 1984 by direction of the Office of the Secretary of Defense (OSD), as a result of the 1983 OSD Steering Committee on Training and Training Technology. TPDC is the OSD focal point for training technology and management information and will collect available training data to design, analyze, and integrate training data bases in support of the entire Department of Defense training community.

C. (U) Project: 2557, Advanced On-the-Job Training System (AOTS). Approximately 70 percent of Air Force technical training is accomplished by on-the-job training (OJT). More than 50 percent of all enlisted members Air Force-wide are undergoing OJT at any one time. However, the OJT system has not changed significantly since its inception almost 40 years ago. Currently, OJT is labor intensive, limited by excessive administrative burdens, and is not responsive enough to unique job site training requirements. This project, classified in the simulation and training devices Congressional category, will develop, implement, and test a prototype state-of-the-art training system that integrates and effectively manages, evaluates, and automates job site training. This will increase OJT effectiveness

and training quality thereby increasing individual and unit productivity, readiness in peacetime, and combat capability in wartime. Advanced On-the-Job Training System (AOTS) will be implemented and demonstrated for four Air Force skill specialties at Bergstrom AFB, TX, in cooperation with Tactical Air Command. This program complements other Air Force maintenance and logistics automation initiatives. In FY 1986, total system hardware and software specifications were developed and development of the AOTS subsystems began. In FY 1987, the major portion of development for the AOTS subsystems will be completed, training requirements will be identified, and job/task data will be assessed. Master task lists for four Air Force skill specialties will be written and a methodology for third party performance evaluation, including criteria for task evaluation, will be developed. FY 1988 efforts will focus on the integration of the Advanced On-the-Job Training System subsystems, as well as the requirements associated with maintenance, reliability, logistics, and transition of the system. During the fourth quarter of FY 1988 the operational test and evaluation (OT&E) will begin. In FY 1989, the OT&E will be completed and the prototype system will be transferred to Tactical Air Command. Throughout development incremental products will be provided to HQ USAF for evaluation and implementation Air Force-wide.

D. (U) Project: 2743, Aircrew Combat Mission Enhancement (ACME). ACME will advance tactical flight simulation by demonstrating and evaluating technologies for realistic tactical combat mission training, as well as combat mission planning and mission rehearsal. These demonstrations and evaluations will help define simulator requirements to meet critical Tactical Air Force needs. The basic approach requires the development of a testbed Combat Mission Trainer (CMT). This testbed CMT will serve as the primary tool for aircrew combat mission training R&D and as the means of integrating future ACME components for evaluation. During FY 1986, engineering feasibility, component requirements, and development approach for the CMT testbed were determined. Development of the testbed will be in three phases: Phase I (FY 1987 - FY 1989) will develop a single ship CMT with full visual, but limited threat and sensor capability; Phase II (FY 1989 - FY 1991) will add a second cockpit to provide a minimum two-ship capability, and Phase III (FY 1991 - FY 1993) will add full multi-sensor (radar, infrared, and visual) and realistic threat and weapon simulations. To support the development of the CMT testbed, the Advanced Visual Technology System image generator will be upgraded to provide full feature textured visual and sensor capabilities and a 60 Hertz update rate for two interactive cockpits. These upgrades began in FY 1986 (in Project 2363) and will be completed in FY 1989. Beginning in FY 1987 the instantaneous field-of-view for the Fiber Optic Helmet Mounted Display (FOHMD) will be increased to 180 degrees horizontally by 80 degrees vertically, providing a field-of-view similar to that available with current flight helmets. The upgraded FOHMD will be completed in FY 1988, integrated into the Phase I CMT testbed and demonstrated in FY 1989. A distributed microprocessor and instructor operator station, components of the CMT testbed, will be developed during FY 1987 and FY 1988. The distributed microprocessor will replace the super minicomputers now used to handle the host computer functions of the simulator, while the instructor operator station will provide the capability to manage two-ship tactical training in a multi-sensor, high threat environment. In FY 1987, a joint effort with the Defense Advance Research Projects Agency (DARPA) will develop the specifications for a network of low cost tactical flight simulators to allow realistic large scale force-on-force combat tactical training (WARNET). WARNET would expand upon the Army/DARPA projects, SIMNET and AIRNET, which are developing a similar network for US Army armor and helicopter simulators, by adding Air Force tactical combat simulators to the network, allowing low cost, realistic, joint service combat training exercises. In FY 1988, joint efforts with the Air Force Wright Aeronautical Laboratory's Avionics Laboratory will explore two alternative approaches to the development of a Miniaturized Real Time Computational System by modifying the

Airborne Graphics Generator and/or the Common Signal Processor (which incorporates Very High Speed Integrated Circuit technology) for use in ground-based flight simulators. The goal of this effort is to develop a low cost, "filing cabinet drawer sized", single channel, miniaturized image generator which would support squadron level combat mission flight training. Also in FY 1988, a joint effort with the Rome Air Development Center will determine the requirements for digital cartographic data to support combat mission rehearsal and mission planning. In FY 1989 and beyond, activities will focus upon defining the relation between the traihing value and CMT complexity, as well as expanding simulation technology to directly address mission rehearsal/mission planning activities.

E. (U) Project: 2922, Personnel Assessment Systems. This project, in the manpower and personnel Congressional category, will provide technology to enable the Air Force to meet its manpower needs for combat readiness and sustainability and for the development of systems to provide management information on individual job performance/requirements. As mandated by Congress, task-level measures of on-the-job performance will be used to validate selection, classification and promotion tests and assess training effectiveness. This project also provides advanced development for the Air Force Officer Qualifying Test and other tests such as the Armed Services Vocational Aptitude Battery (ASVAB). Replacement of Service tests and test batteries is required to avoid obsolescence, to provide alternative tests for selection continuity in case of test compromise, and to incorporate improvements identified in ongoing exploratory test research programs. As the Department of Defense Executive Agent for ASVAB development, the Air Force must ensure that the it meets the needs of all Services and must update and revise the test battery. In FY 1986, job performance measures for four Air Force specialties were developed. The measures for Jet Engine Mechanics were tested and analyzed, and the data transferred to the Navy and Marine Corps. Also in FY 1986, data collection began for three other skill specialties: Air Traffic Controller, Avionic Communications Specialist, and Ground Radio Operator. Analyses of these data will be completed in FY 1987. Job performance measures for four additional specialties will be developed and tested in FY 1987, with completion of the analyses in FY 1988. Development of new prototypes for both the enlisted and officer selection test batteries will continue in FY 1987 and FY 1988. Future efforts will explore computer-based/computer-adaptive approaches to officer selection and classification. Development, evaluation, refinement, and application of performance measures will also continue, as will validation and cost/benefit analyses of the measures. In FY 1989, a new system for selecting pilots for fighter/attack/reconnaissance or multi-engine heavy aircraft will be delivered for field use. Also in FY 1989, job performance measures will be developed for eight additional specialties.

F. (U) Project: 2949, Basic Job Skills Assessment and Enhancement. This project, included in the education and training Congressional category, will develop and demonstrate an adaptive training system focusing on the basic functional and enabling job skills, that is, the core knowledge content, and associated thinking processes, that enable early technical proficiency and thus bring the first term airman to a functional level faster. Of particular interest are the skills required in workplaces heavily influenced by technology. This training system, incorporating data collected in Program Element 62205F on the intellectual requirements of various jobs and workplaces, will thus provide Air Force decision makers with scientifically valid, job-oriented measurement and training, to ensure that airmen possess the basic job knowledge and skills needed to perform and progress satisfactorily during the first term of enlistment. Another effort within this project will provide a top-down, structured approach to system redesign and reprogramming to make the Comprehensive Occupational Data Analysis Programs (CODAP) system, more efficient, easier to

maintain, and more user-friendly. Comprehensive Occupational Data Analysis Programs (CODAP), the primary operational Air Force occupational analysis tool, is rapidly becoming antiquated and difficult to maintain. The original CODAP system has resulted in an estimated cost avoidance of over $3 million per year since its implementation in FY 1968. Benefits of the updated CODAP include: state-of-the-art analytical, statistical, and reporting procedures; techniques for longitudinal analyses of job content; techniques for developing more job-related enlisted promotion tests; and techniques for matching weapon system acquisition tasks with related personnel skill requirements. In FY 1986, initial building of instructional modules for identified job prerequisites began, as did the development of specifications for evaluating training effectiveness which will be validated against job performance. In FY 1987, a series of advanced development tasks will be initiated to develop a prototype occupational measurement system with advanced task and job clustering capabilities and automated job typing procedures; software development will be completed by the end of FY 1988. The development of training modules for 125 Air Force specialties will begin in FY 1988, and specifications for training effectiveness evaluation and validation will be completed. Comprehensive training implementation plans will also be completed in FY 1988. In FY 1989, development of a basic job skills extended job family trainer for 12 Air Force specialties will be completed and tested. This technology will reduce the number of marginal performers in the Air Force and reduce overall training time. Savings from reduced attrition could reach as much as $10 million per year. Also in FY 1989, operational test and evaluation of the prototype occupational measurement system will begin. A thoroughly integrated and tested system will be transitioned to Air Training Command by the end of FY 1990.

G. (U) Project: 2951, Training Decisions System (TDS). This project, included in the education and training Congressional category, will provide a computer-based system which will aid in optimizing training designs for Air Force specialties. It will establish the basis for management decisions on what to train, where to train, and when to train. Because of the scope of Air Force technical training, many decisions with major impacts on training are made independently and at different times, by management activities responsible for different parts of the training and personnel systems. Coordinating such efforts is complex, and relevant data are not always available at key decision points. For example, the content of resident technical school training is largely determined by predefined budgets, and whatever content is not covered in the school is left to on-the-job training (OJT) without systematic appraisal of long-term costs or unit capacities for an increased load on OJT resources. Current practice does not include adequate consideration of all relevant factors, such as costs and alternative patterns of personnel utilization, in making basic decisions regarding the what, where, and when of personnel training. Benefits from this project include reduced training costs, improved allocations of training content and resources, better alignment of training content with job task requirements and reduced training workload on operational Air Force units. When operational, projected savings plus cost avoidance are expected to be very high. In FY 1987, design specifications will be completed. Advanced development of the TDS will begin in FY 1988. Computer-assisted decision aids describing optional ways of configuring airman jobs, training states, and career paths within given specialty areas will be completed, tested, and transitioned by FY 1992.

H. (U) Project: 3056, Air Combat Assessment and Debriefing System (ACADS). This project, initiated in FY 1987, will design, develop, demonstrate, and evaluate a prototype air-to-air and air to-ground attack performance measurement and debriefing system for use at the squadron level. The system will include a recording device to monitor and record flight parameters on-board the aircraft, a data link between aircraft to share positional and threat information, and a

ground-based processing system for performance analysis and replay for training evaluation. This will enable theimplementation of missile fly-out models for real-time kill assessment. Today, this type of objective performance evaluation for flight operations is available only at a limited number of fixed dedicated training ranges having instrumentation. Deployment to these ranges is costly and access is limited. ACADS will provide this capability for routine local area training missions at considerably reduced costs to the Air Force. In FY 1987, development of a breadboard system for a flight of four F-16 aircraft will begin. Demonstrations and evaluation of the individual components including the data recording capability and real-time performance assessment will begin in FY 1988. In FY 1989, component integration and system testing will begin. In FY 1990, the prototype Air Combat Assessment and Debriefing System will be completed. Outyear efforts will include demonstration of transportability of the technology to the F-15E, component downsizing, and development of a production specification.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: A cooperative agreement exists between the United States and Canada for the development of a Fiber-Optic Helmet-Mounted Display System (FOHMD) for flight simulators. The system uses lightweight optics to present high resolution, color, computer-generated images on glass plates directly in front of the pilot's eyes; thus eliminating very large and costly optics and/or domes otherwise needed to simulate the visual scene available in a modern fighter aircraft cockpit. The FOHMD will provide the flight simulator display capability required for advanced tactical training applications. This effort is a joint US/Canadian cost-plus-fixed-fee contract with the Canadian Commercial Corporation, Ottawa, Canada. Work is being performed by CAE Electronics Ltd., Quebec, Canada. The joint cost-sharing agreement has been in effect since July 1981. Through FY 1986, Canada has obligated $3.463 million and the United States has obligated $4.862 million through projects 2363 and 2743, in PE 63227F. The program is in advanced development. A lightweight eye-tracked prototype helmet mounted display was delivered to the Operations Training Division of the Air Force Human Resources Laboratory in June 1986. An upgraded FOHMD, incorporating refinements necessary for Tactical Air Command acceptance, will be completed in FY 1988, integrated into the Combat Mission Trainer testbed, and demonstrated in FY 1989. To carry the program through to completion, Canada has programmed $3.08 million in FY 1987 and FY 1988; the United States has programmed $1.681 million in FY 1987 and FY 1988. Total funding under this joint cost-sharing agreement is $13.086 million, divided evenly between Canada and the United States.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63231F
DOD Mission Area: 552-Environmental and Life Sciences (ATD)

Title: Crew Systems and Personnel Protection Technology
Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986* Actual	FY 1987* Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	15,505	19,584	23,252	24,780	Continuing	N/A
2722	Aerospace Chemical Warfare Defense	4,055	5,009	3,833	4,197	Continuing	N/A
2829	Cockpit Automation Technology	4,300	6,149	6,544	7,297	Continuing	N/A
2830	Advanced Life Support Systems	2,500	2,764	1,360	2,948	Continuing	N/A
2868	Crew Escape System Technology	4,600	5,016	5,532	2,448	Continuing	N/A
2992	Space Crew Enhancement	50	646	973	1,540	Continuing	N/A
3256	Advanced Strategic Aerospace Crew Systems	0	0	0	1,650	Continuing	N/A
3257	Virtual Image Cockpit	0	0	5,010	3,200	Continuing	N/A
3281	Human Centered Technology for Command, Control and Communications	0	0	0	1,500	Continuing	N/A

*Prior years reflect FY 1988 Science and Technology restructure for comparability purposes only. Work under Project 2722 was formerly documented as PE 63745F, Chemical Warfare Defense, and is consolidated here to comply with Congressional direction to reduce the number of program elements.

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Weapons system development has reached the point where the operator may become the limiting factor in total system performance and mission success. The performance envelope of the weapons system, extreme aerospace environments and combat threats can exceed the protective capabilities of life support systems, limiting operations while placing severe physical demands on the operator. Information available concerning the status of the weapons system and mission is so complex and fluid that it can exceed the operator's ability to perceive, decide, and act on that information. Both physical and mental demands can place the operator in situations from which he cannot recover, while modern aircraft tactics and mission scenarios continually create environments from which there is low probability of successfully ejecting in an emergency. This program element provides advanced development and demonstration of concepts to protect and extend the performance of the crewmember in the hazardous aerospace environment. It demonstrates the capability to operate and escape at the extremes of the performance envelope and develops ways to maximize decision making by the system operator. The program focus is on the crewmember in the cockpit or crew station but logically extends to other air and ground personnel conducting mission-essential operations and support. Recently incorporated efforts on chemical warfare defense ensure integrated consideration of this serious threat to the spectrum of aerospace operations. Supporting many system development programs and over fifteen formal Statements of Need on specific requirements from Headquarters Air Force and Major Commands, the emphasis of this Science and Technology effort remains on total personnel protection and improved performance of human-centered systems to support mission accomplishment.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
RDT&E Total	16,080	21,054	16,142	N/A	Continuing	N/A
Prior PE 63231F	11,207	15,905	12,309	N/A	Continuing	N/A
Prior PE 63745F	4,873	5,149	3,833	N/A	Continuing	N/A

EXPLANATION: (U) All years adjusted for inflation or minor reprogramming actions. FY 1987 cut $0.9 million as portion of undistributed Congressional reduction. FY 1988 increased $2.7 million in Project 2868 to meet essential full-system testing requirements and contract obligations. FY 1988 further increased $5.0 million in Project 3257 to capitalize on a firm foundation of advanced work done in this area and to meet near-term technology application opportunities.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: Projects have evolved from exploratory development in PE 62202F, Aerospace Biotechnology, and represent a key link in the demonstration of technologies prior to full-scale development through PE 64706F, Life Support Systems; PE 64703F, Aeromedical/Chemical Defense Systems; PE 64601F, Chemical/Biological Defense Equipment; or engineering program offices. Products are provided to Aeronautical Systems Division (ASD), Aerospace Medical Division, Electronic Systems Division, Space Division, and other organizations in accordance with well-coordinated, signed technology transition agreements. Joint planning and participation in steering groups assure compatible phasing of total weapon system development goals. Life support activities are included in ASD's Ten-Year Life Support Master Development Plan and are coordinated through the Tri-Service RDT&E Steering Group reporting to the Joint Logistics Commanders. Space-related activities are coordinated with other services or agencies and with the National Aeronautics and Space Administration through joint participation in the Air Force Scientific Advisory Board and the Space Technology Interdependency Group, consultation on requirements, and cooperative research covered by memoranda of agreement. Laser protection is coordinated through the Tri-Service Laser Hardened Materials and Structures Group, chaired by Office of the Under Secretary of Defense for Research and Engineering (OUSDR&E). Man-machine integration activities are coordinated through the Defense Human Factors Technology Advisory Group and topical reviews by OUSDR&E. Cockpit and crew station design activities are coordinated through a Tri-Service Initiative Panel chartered by the Joint Directors of Laboratories and chaired by the Cockpit Automation Technology (Project 2829) Program Office. Project 2722 was previously funded in PE 63745F, Chemical Warfare Defense. The Army is DOD lead agency for Chemical Warfare Defense, and only efforts that have specific Air Force relevance or that can be done more economically using Air Force expertise are included in this project. Areas with multiservice application are identified in a Joint Services Research, Development, and Acquisition Plan for inclusion in the Army's overall chemical defense research program. Medical chemical defense efforts are further coordinated through the Armed Services Biomedical Research, Evaluation and Management Committee.

6. (U) WORK PERFORMED BY: This program is conducted by the Aerospace Medical Division, Directorate of System Acquisition, Brooks AFB, TX, with assistance from its laboratories, the United States Air Force School of Aerospace Medicine and Air Force Human Resources Laboratory, Brooks AFB, TX, and the Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH; and through memoranda of agreement with other laboratories, divisions and commands. The program is conducted principally through contracts with the following prime contractors: Boeing Military Airplane Company, Seattle, WA (Projects 2829, 2830, 2868); Northrop Corporation, Aircraft Division, Hawthorne, CA (Project 2829), A.D. Little, Inc., Cambridge, MA (Project 2722); Scott Aviation-Sierra Products, Inc., Monrovia, CA (Project 2722); Battelle Laboratories, Columbus, OH (Project 2722); Pall Corporation, Glen Cove, NY (Project 2722); and ILC Dover, Frederica, DE (Projects 2722, 2992).

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project 2722, Aerospace Chemical Warfare Defense. This project began as a separate program element in FY 1982 to meet a critical need to defend our forces and sustain military operations in a chemical warfare environment. The project's goal remains to ensure the protection and performance of aerospace mission and support personnel, the maintenance of combat sortie generation rates, and the adequate treatment of combat casualties. In close coordination with the Army, a set of systems analysis concepts (master plans) establish total Air Force requirements based on operational needs. Technology development plans are generated and ongoing trade-off studies conducted to meet Air Force-unique requirements through development of such technologies as: (1) detection, identification and warning equipment; (2) procedures, equipment and facilities for decontamination or avoidance of toxic agents; (3) air and groundcrew protective equipment or clothing compatible with aircraft design and operations; (4) collective protection systems such as crew shelters and chemically hardened aircraft environmental control systems; and (5) specific medical and air evacuation support items essential for patient care in a toxic environment. FY 1986 Accomplishments: A Fit-Test Instrument for quantifying the leakage of protective masks and a Personal Equipment Contamination Sensor, the first hand-held detector for liquid agents on surfaces, were both successfully demonstrated at the SALTY DEMO Airbase Survivability Exercise in West Germany and transitioned to full-scale development. The toxicity of a nonpersistent chemical agent simulant was determined and recommendations were prepared concerning its potential use in training. To address the Air Force's top priority chemical defense area of aircrew eye-respiratory protection, two aircrew respirators/masks (one Dutch) were tested and transitioned as candidates for full-scale development. Single-agent test exposures were conducted on molecular sieve systems to study the vulnerability of on-board oxygen generation systems (OBOGS) to chemical attack. Work was completed on an Aircrew Filter Assembly to increase individual respirator protection by 200% while decreasing breathing resistance. Concept definition studies were completed for controlling contamination in medical shelters and while entering/exiting aircraft. FY 1987 Plans: Work will continue on molecular sieves and cockpit filtration systems. Protocols for the field diagnosis and treatment of chemical casualties will be completed and delivered to the Surgeon General. Comparative testing will be conducted on Air Force and Army prototype Vital Signs Monitors, which determine patient status without removing protective clothing. Two breadboard prototypes will be made of a Chemical Vapor Cockpit Sensor, a low-cost system for determining contamination levels in aircraft and personnel shelters. Toxicology analysis of candidate persistent chemical agent training simulants will be conducted. Hardware development will begin for an advanced multi-man groundcrew cooling system to relieve thermal stress from extended flightline operations in chemical defense gear. Work also will begin on the design and brassboard fabrication

of a stereophoto method to quickly size individuals for chemical defense gear. FY 1988 Plans: This year will contain central efforts on a Contamination Control Systems Analysis to determine the tradeoffs for decontaminating various air combat systems and to provide recommendations on where decontamination efforts should be focused. A prototype system for estimating casualties and attrition factors, successfully demonstrated at SALTY DEMO, will be developed for world-wide application in airbase exercises and planning activities. Following a two-year development effort, testing and preparation for transition to full-scale development will occur for a Fixed-Site Chemical Detection and Warning System to provide real-time networked attack and contamination data. This development supports critical maintenance of airbase operations during chemical attack, as will testing of the Chemical Vapor Cockpit Sensor. Efforts will continue on stereophoto equipment sizing, the Vital Signs Monitor, and the groundcrew cooling system. Use of the Army XM-21, a passive remote detector for airbases, will be assessed. FY 1989: The stereophoto sizing device and Chemical Vapor Cockpit Sensor will be transitioned for full-scale development after final testing, and the Contamination Control Systems Analysis will be completed. Work will begin on an advanced, portable Multiphoton Mass Spectroscopy Detector to permit on-site identification of any unknown chemical agents and on improved methods for wound or skin decontamination. The threat-related attrition model developed for airbase survivability and operability exercises will be modified to add nuclear/biological effects, ground-launched cruise missile operation, and projected air combat losses. Requirements for project efforts will continue to be evaluated and adjusted based upon limits to mission capability imposed by chemical protection equipment and the identification or fielding of new threat agents.

B. (U) Project: 2829, Cockpit Automation Technology (CAT). The CAT project provides quantitative tools and procedures to permit the *extensive application of human factors* principles early in the development cycle of manned aerospace vehicles. The resulting design process will determine the cost-effective use of cockpit/crew-station automation technologies based on crew needs and mission requirements. It will also help reduce system program costs and risks currently associated with numerous cockpit engineering change proposals and retrofits. For the first time, a coordinated and auditable process will permit quantifiable trade-offs between airframe, avionics and cockpit design in advance of full-scale development decisions, as well as provide insight into the potential consequences of later modifications to avionics and weaponry. Resultant military standards, design handbooks and computer-assisted procedures will be available to the military services, NASA and contractors. FY 1986 Accomplishments: Phase I, system definition, was completed. Prototype design processes were applied to an analysis of four automation concepts (e.g., automatic target designation) and were evaluated using such measures as crew workload and simulated-combat performance with the CAT mission scenarios. These detailed, pilot-centered tactical scenarios involve air-to-air and air-to-ground missions in a rigorous mid-1990's threat environment. Analytical software was demonstrated for crew station architecture, man-machine function allocation, and task timeline analysis. Dual cost-share contracts were awarded for competitive 24-month efforts on program Phase II, design process development. Work began to provide detailed requirements for hardware and software. FY 1987 Plans: This year encompasses core efforts in CAT process development. Analytical and empirical tools from Phase I will be intensively evaluated and combined into a structured process for crew station development which is phased with the weapon system acquisition cycle. A computer-aided design support system will be developed, and the CAT methodology will be exercised through designing a representative fighter cockpit. The baseline design will be defined, mission analyses applied and automation concepts evaluated. A design lessons-learned data base will be developed and a complete audit trail of design decisions will evolve. Systems engineering, test planning, and transition preparation will be accomplished. FY 1988 Plans: Phase II will be completed, producing a fully-developed

design process, a computer-aided system for real-time testing of new design concepts, and a fighter cockpit specification. Analytical and part-task simulations will be performed to test measures of effectiveness for the designed cockpit. Upon exercise of the Phase III contract option, a single contractor will conduct full-mission ground-based simulations, with participation by Air Force crews, to verify the design process while demonstrating adequacy of the representative cockpit design. A reconfigurable breadboard cockpit simulator will be used for gathering empirical design data. Work will begin on concepts and quantitative methods for further design validiation through the potential comparison of simulator results to crew/cockpit in-flight performance. FY 1989 Plans: Phase III, system demonstration, will continue as the Cockpit Automation Technology (CAT) design process is refined based on part-task and part-mission simulator tests. Software analysis programs will be revised and fully documented into proposed automation design guides. The breadboard cockpit simulator will be interfaced with the computer-aided design support system, and a full-mission simulator will be configured for validation testing. Transition training will be initiated for DOD system acquisition personnel to use the developed process. Design reviews will be held for data acquisition hardware appropriate for in-flight measurements to support the design process. In accordance with signed agreements, CAT products and the fighter cockpit specification are provided to the Advanced Tactical Fighter (ATF) System Program Office (SPO) for ATF development, as well as to the Aeronautical Systems Division (ASD) Engineering for incorporation into the Air Force cockpit qualification process. A technology bonus has been the CAT mission scenarios, which have already been applied by more than twenty other Tri-Service and government development programs.

C. (U) Project: 2830, Advanced Life Support Systems (ALSS). The ALSS project provides integrated protection for aircrew to the extremes of the performance envelope of modern aircraft and mission scenarios. The concepts to be developed and demonstrated will provide protection for emergency descent from altitudes up to 60,000-70,000 feet, sustained acceleration of nine G, excessive thermal burdens with cockpit-equivalent temperatures to 122°F (50°C), chemical agents, and vision protection for known laser and nuclear flash threats. Current operational equipment burdens the pilot with cumbersome chemical defense gear and provides no protection from elevated cockpit temperatures, altitude protection to only 50,000 feet, limited ocular protection and acceleration protection which does not match the capabilities of current fighter aircraft such as the F-16. FY 1986 Accomplishments: A formal technology transition plan was signed by the Life Support SPO, ASD Engineering and the ATF SPO. Component fabrication, subsystem ground development test and man rating continued. Subsystems were integrated into the full system and further ground tested. The system consists of the following: liquid cooled garment; high-pressure mask for positive pressure breathing; molecular sieve oxygen generation; head protection; nuclear flash visor; laser visor; night vision enhancement; anti-g valve; partial pressure garments; equipment connectors; and seat modifications. An Integrated Support Plan appropriate for an advanced development effort was completed. FY 1987 Plans: With three complete systems provided by the contractor for test purposes, the integrated tactical system will be fully flight tested in a modified F-15B aircraft under simulated combat conditions. In coordination with the Life Support SPO, other tests will be conducted in an F-16 to determine the effectiveness of ALSS-derived positive-pressure breathing and G-suit systems in protecting against G-induced loss of consciousness, with the aim of an early transition of this technology to our existing fighter fleet to combat pilot fatalities. The tactical system will also be adapted for use by the U.S. Navy in F-18 flight evaluations. Work will be completed on a Modified Life Support System appropriate for use in advanced strategic applications. Additional work will be performed on ocular protection integration to comply with congressional emphasis in FY 1987 budget deliberations. Finally, efforts will begin on follow-on life support systems to meet evolving aerospace threats

and aircraft performance environments. FY 1988 Plans: Follow-on life support efforts will enter the subsystem design phase, and appropriate developmental testing and evaluation will begin. The first of these systems is a second-generation tactical system to incorporate evolving improvements in ballistic protection, hypothermia protection, augmented G-protection and protection from advanced laser threats as well as integration of vision enhancement and available helmet-mounted display systems to ensure compatibility with life support equipment. The second system will meet special needs of the Strategic Air Command's extreme altitude aircraft in missions of reconnaissance and Command, Control, Communications and Intelligence. Especially important is the need for an improved full-pressure suit to meet recent changes in operational requirements with expansion of the TR-1 (in addition to the SR-71) mission in the European Theater. This requires a system that provides protection from a full spectrum of threats and physiological hazards at altitudes in excess of 80,000 ft and speeds in excess of Mach 3 with provisions for more rapid deployment, longer missions, and improved decontamination capability for rapid aircraft turnaround and sortie generation. FY 1989 Plans: Life support systems will enter the advanced design phase for flight worthiness qualification. Extensive flight safety and subsystem compatibility testing will be accomplished in preparation for in-flight evaluations. Special mission profiles from the Strategic Air Command and Tactical Air Forces will be flown in representative aircraft to test adequacy of prototype designs. Additionally, Tri-Service requirements will be addressed during the design and testing phases to achieve DOD commonality.

D. (U) Project: 2868, Crew Escape System Technology (CREST). The CREST project integrates advanced subsystems into an ejection seat capable of protecting aircrew throughout the performance envelope of modern aircraft. The goal is to significantly reduce fatalities and major injury rates in emergency ejections at all speeds between 0 and 700 knots, especially with adverse aircraft attitude and non-level flight at low altitude. While approximately doubling the current safe ejection envelope, CREST also will provide significant improvements in reliability, maintainability and logistics supportability over current ejection seats. The CREST program will demonstrate an escape capability for aircraft of the future while developing many technologies which also will permit upgrading of existing ejection seats. FY 1986 Accomplishments: A Preliminary Design Review was held, with emphasis on complete subsystem design of each CREST technology, and authorization was given subsequently to begin program Phase IIB, a 2-year Critical Design effort. Subsystem fabrication and extensive testing included such technologies as windblast protection, rocket motors with thrust-vector control nozzles, and ejection seat flight-controller programming. Development of equipment for full-system tests concentrated on rocket sled test fixtures and an advanced instrumented manikin capable of adequately modeling and testing dynamic response in an extreme ejection environment. Initial laboratory human-impact studies were conducted to validate restraint subsystems. FY 1987 Plans: This is the central year for critical design and fabrication of advanced subsystems, which will then be tested individually under lab conditions to verify design assumptions and to validate integration concepts. Ground tests will include the digital control subsystem, the variable-thrust seat catapult, integrated windblast controls, and the parachute deployment subsystem. Seat mock-ups and prototypes will be evaluated. Final development of the advanced test manikin will lead to its testing, as will the completion and delivery of a rocket sled assembly for firing the ejection seat while moving along multiple axes. Centrifuge testing of the restraint subsystem will be conducted. FY 1988 Plans: Phase IIB, Critical Design, will be completed as program Phase III begins for full-system demonstration. In the culmination of prototype ejection seat engineering development, all subsystems will be integrated as seat hardware is fabricated and assembled in preparation for full-system testing. The advanced manikin and rocket sled test assembly will be fully integrated into the program as initial environmental

tests and static ejection seat tests are conducted, leading to subsequent dynamic tests. FY 1989 Plans: Dynamic rocket sled and in-flight tests will be conducted to demonstrate ejection seat performance through a range of operational and projected ejection environments. Parallel computational simulations will be conducted to validate and integrate actual test data. As tests on the Crew Escape System Technology (CREST) seat verify its performance in MACH 3 environments and its suitability for transition to full-scale development, follow-on investigations will begin to support eventual hypersonic ejection systems to meet the requirements of future manned aerospace vehicles. The transition products for the current CREST effort will include complete design specifications and a tailored logistics support analysis appropriate to advanced development. Transition agreements exist with the Life Support System Program Office (SPO), Advanced Tactical Fighter SPO, and U.S. Navy. Additionally, test fixtures and instruments used in CREST testing will be made available to other developmental efforts in ejection and impact technology.

E. (U) Project: 2992, Space Crew Enhancement (SPACE). The SPACE project demonstrates man-machine integration and crew protection systems needed to exploit or enhance man's ability to support traditional military missions from space. To ensure effectiveness of military space-related systems, whether ground-based or space-based, human engineering concepts must be employed to optimize performance. This program will help define man's potential roles in military space systems as well as quantify the trade-offs of manned versus unmanned space systems to support such tasks as logistics and surveillance. It will demonstrate concepts and technologies to ensure life support, crew performance and crew protection in the complex and potentially hazardous environment unique to military space systems. A specific area of near-term interest includes support for the development and deployment of a transatmospheric vehicle, which has potentially different launch and egress response times, flight durations, acceleration profiles and performance characteristics, or operator workload and task requirements than the space shuttle. FY 1986 Accomplishments: Funding for this project began in FY 1986. Vision data collected under PE 62202F, Aerospace Biotechnology, was used to evaluate the feasibility of an optical acquisition and tracking system for space-based surveillance. Identification of crew performance and protection concerns for the National Aerospace Plane (NASP) was performed. In coordination with the National Aeronautics and Space Administration (NASA), a contracting effort was initiated to develop enhanced mobility modifications in an advanced near-space or transatmospheric pressure suit for non-extravehicular activity environments. Extensive government coordination continued, and a report placing this project within a crew systems technology context was forwarded to Congress. User requirements and technology transition were coordinated with Space Command, Space Division and the NASP Program Office. FY 1987 Plans: The program will begin developing human factors performance definitions and design criteria applicable to demonstrating military crew stations for advanced aerospace systems, such as the NASP. Prototype pressure suit modifications will be developed and demonstrated. Efforts will be coordinated with NASA on in-helmet displays, and work will begin to define system specifications for enhanced radiation protection appropriate for polar orbit missions. The visual acquisition system will be evaluated for further development and demonstration based on user requirements and priorities. FY 1988 Plans: Transition products from the initial space suit modification contract will be evaluated as concept studies are conducted for further modifications. Initial aircraft tests of the visual acquisition and tracking system will be conducted. Work will begin on military-unique features of helmet-mounted displays for presenting logistics data to spacesuited crewmembers during extravehicular activity. FY 1989 Plans: Demonstration of the visual acquisition tracking system will lead to an evaluation of its utility in space operations. The program will continue to develop specifications and subsystems for military space suits, to include provisions for shorter egress times, improved logistics supportability, advanced in-helmet displays

and increased radiation protection. Efforts will also continue to incorporate crew station design criteria and advanced control/display technologies into required military-unique systems. Efforts to ensure clear definition of user requirements and well-coordinated product transitions will be ongoing.

F. (U) Project: 3256, Advanced Strategic Aerospace Crew Systems (ADSACS). This project was approved and initiated as an Air Force new start for FY 1987, but with specific resources initially not identified until FY 1989. It addresses the crew systems needed for strategic aircraft strikes against relocatable targets. No aircrew has ever been required to locate, acquire and strike strategic relocatable targets (SRTs); and no man-machine system or human factors analysis of system requirements exists to ensure mission success. Through analysis and ground-based demonstrations with man-in-the-loop simulation, this project will define the crew structure and functional requirements for existing and future aircraft to accomplish this mission. Major tasks include determining crew capabilities, quantifying sensor/display performance requirements, integrating real-time Command, Control, Communications and Intelligence, ascertaining target acquisition probability in the face of electronic countermeasures and deception, and demonstrating appropriate crew stations to optimize performance. FY 1986 Accomplishments: Monitoring of exploratory development and analyses continued. The ADSACS development approach was coordinated with the Strategic Air Command and Aeronautical Systems Division, who continued to support the program and validate the military need. A coordinated planning effort involving SRTs was completed, producing a detailed ADSACS mission scenario description which will be sent to the joint Air Force Systems Command and Strategic Air Command SRT working group. FY 1987, FY 1988 and FY 1989 Plans: The program development plan will be reevaluated and updated in preparation for initial funding and other resource allocation to this program. Acquisition planning will be completed and coordinated through appropriate channels. Technology transition planning will be conducted and, as FY 1989 funds become available, part-mission simulation will begin using segments of the previously developed mission scenario.

G. (U) Project: 3257, Virtual Image Cockpit (VIC). This effort was approved and initiated as an Air Force new start for FY 1987, but with specific resources initially not identified until FY 1989. As a result of the increased visibility of this project with recent long-term Air Force planning efforts and identification of near-term important technology transition opportunities, external resources were received to assure a strong start. This project develops and demonstrates maturing concepts for enhancing the man-machine interface in aerospace systems, specifically the high-performance, high-stress environment of advanced fighter aircraft. The effort provides technologies for innovative visual, aural and tactile controls and displays using unique "virtual world" concepts that effectively surround the pilot with easily assimilated information to maximize situational awareness. Natural body movements, voice and multiple sensory inputs are integrated to give the pilot a coherent picture of his environment and mission status while performing complex control functions. Computer-assisted functions decrease pilot workload, and the system can monitor the pilot so that decrements in physiological status can be compensated for. FY 1986 Accomplishments: A program development approach was coordinated with Tri-Service users, and an Air Force roadmap was developed to ensure integration of this effort with other cockpit-centered technologies. Exploratory research was monitored as concept development continued on such technologies as advanced displays in projected image format; night visual systems; head-, eye-, voice-, and pointing-coupled control systems; a software reconfigurable operational cockpit; and automated decision aiding. FY 1987 Plans: Laboratory resources will be coordinated to support this program, and a system definition study will be conducted using funds provided by PE 63248F, Concept Development. Plans will be completed

for exploiting and tailoring prior advanced technology development in this area conducted by the Air Force for NASA and the Army Light Helicopter (LHX) programs. Monitoring of ground-based exploratory development demonstrations will continue, and system performance specifications will be refined. The development plan and acquisition strategy will be coordinated with users and full-scale development offices, and technology transition planning will occur. FY 1988 Plans: Building on a firm research background, and with required initial equipment purchases under established contracting vehicles, development will begin on the head-aimed fire control components of an All-Aspect Head-Up Display (HUD) that will give the pilot control and display information wherever his eyes are directed. A study will be conducted on its tactical utility, and lightweight headgear will be developed appropriate to demonstrating helmet-mounted technologies. Ultimately, the system will integrate a helmet display driven by a subminiature cathode ray tube, a helmet orientation/position tracking system for visual command and control, a lightweight helmet and necessary supporting system electronics. It will be designed to significantly augment or replace more costly and limited field-of-view HUDs currently in operational use. FY 1989 Plans: Development of the All-Aspect HUD will continue, leading to tests of the head-aimed fire control system. Work will be conducted on a Night Vision Goggle/HUD to enhance situation awareness under adverse weather or night conditions. Further work under this project will continue its aggressive development and integration of technologies which are central to an advanced, human-centered Super Cockpit that will greatly expand aerospace man-machine capabilities. The program schedule supports near-term product transition opportunities for the Advanced Tactical Fighter, spinoffs to other aircraft and the evolution of a new family of control and display technologies for future advanced aerospace systems.

H. (U) Project: 3281, Human Centered Technology for Command, Control and Communications (C^3). This effort was approved and initiated as an Air Force new start for FY 1987, but with specific resources initially not identified until FY 1989. It develops and demonstrates technologies to enhance human operator effectiveness in national, strategic and tactical C^3 systems. It demonstrates required crew systems for effective battle awareness and management of military forces in all phases of conflict, demonstrating mission performance through realistic mission environment simulations. Crew workstations are defined which make best use of the human operator in automated command and control networks. Training procedures and systems are defined for effective team decision making and use of C^3 systems with decision aids. FY 1986 Accomplishments: Exploratory development continued to address technology options in both strategic and tactical C^3 networks. Developments monitored for potential transition to advanced development under this program included an integrated workstation incorporating communication and display features, as well as a computer-based training system covering command and control information for battle managers of NATO forces. Interlaboratory agreements were coordinated to bring together hardware, software and human performance technologies. Coordination continued with user commands to ensure validity of the developmental approach. FY 1987, FY 1988 and FY 1989 Plans: Monitoring of exploratory development will continue. Performance specifications will be defined and updated to match military requirements. Acquisition strategies, development plans and technology transition plans will be coordinated in preparation for FY 1989 resource allocation. Development will begin of a joint laboratory capability involving a network for near real-time simulation of distributed C^3 systems. Also, development will begin on knowledge-based engineering systems for decision making training. Tasks focus on the ultimate development and testing of human-centered technologies for survivable (including mobile) strategic C^3 systems and on ways to cut tactical Air Tasking Order generation time, critical to responsive management of air assets, by several hours.

Program Element: 63231F Title: Crew Systems and Personnel Protection Technology
DOD Mission Area: 552-Environmental and Life Sciences (ATD) Budget Activity: 2 - Advanced Technology Development

8. (U) PROJECTS OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not applicable for funded agreements directly with Air Force, although some subcontractors are currently in the United Kingdom and Canada. The overall program element maintains international coordination through the Air Standardization Coordination Committee, NATO Advisory Groups for Aerospace Research and Development (AGARD), and specific Data Exchange Agreements with various countries.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63245F
DOD Mission Area: 523 - Engineering Technology (ED)

Title: Advanced Flight Technology Integration (AFTI)
Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate*	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		21,355	28,902	29,734	32,904	Continuing	N/A
2061	Attack Technology	2,153	1,675	600	3,651	Continuing	N/A
2568	Mission Adaptive Wing	391	2,100	1,000	0	0	31,970
2682	Short Takeoff and Landing/Maneuver Technology Demonstrator	18,611	14,603	14,352	13,139	Continuing	N/A
2979	Reliability and Maintainability for Flight Technology Integration	200	1,658	1,900	1,500	Continuing	N/A
3391	X-29 Advanced Technology Demonstrator	0	8,500	8,500	3,700	1,000	21,700
3417	Boost Glide Vehicle Demonstration	0	366	3,382	10,914	Continuing	N/A

* Subsequent to submission of the R-1, $3.8 million has been reprogrammed into the program element bringing the total to $28.902 million for FY 1987.

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Science and Technology program validates under flight operational conditions, technologies to make future aerospace vehicles as effective and efficient as possible, while improving performance and reliability. As such it is a major contributor of validated technologies for future weapon systems. This is accomplished through system level flight testing of fully integrated sets of synergistic technologies under simulated mission conditions. This testbed approach gives early indications of the benefits that integrated technologies can give future production systems, at one-tenth the full-scale development cost. Emphasizing technology at a system level (proven under operational conditions) ensures that a base of proven technology is available to support development of the next generation of flight vehicles. These data enable the Air Force to concentrate on design options during full-scale development efforts. This PE integrates and flight validates the technology provided by Flight Vehicle Technology (PE 63205F) as well as by other PEs. The most pressing needs currently being addressed are for integrated test demonstrations of reliable air combat, strategic interdiction, tactical survivability, strategic endurance, and damage tolerance technologies. In FY 1988 the programs to validate these needed capabilities include Integrated Control/Avionics for Air Superiority, the Strategic Boost Glide Vehicle, the Short Takeoff and Landing/Maneuver Technology Demonstrator, the Mission Adaptive Wing, the X-29 Advanced Technology Demonstrator, and Self-Repairing Flight Control Systems.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	19,203	30,679	28,741	N/A	Continuing	N/A

EXPLANATION: (U) Add in FY 1986 funded Proj 2682 shortfall. FY 1987 reduction is due to Congressional action.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: PE 63205F, Aerospace Vehicle Technology provides component technologies that are integrated and flight tested in PE 63245F. PE 63253F, Advanced Avionic Integration, also provides basic avionics algorithms used to develope flight control software. PE 63211F, Aerospace Structures and Materials; PE 63203F, Advanced Avionics for Aerospace Vehicles; the Army's Advanced Rotorcraft Technology Integration program, and the National Aeronautics and Space Administration (NASA) also participation in program planning and flight tests. Navy, Air Force, and NASA efforts are coordinated by the Aeronautical Flight Technology/Research Activities Coordinating Group and the Office of the Secretary of Defense. Memoranda of agreements between all three Services and NASA assure maximum transition of technology and no duplication of effort. The X-29 program is a jointly funded with NASA and DARPA.

6. (U) WORK PERFORMED BY: This program element is managed by the Flight Dynamics Laboratory, Wright-Patterson AFB, OH. Contractors are General Dynamics Corporation, Ft. Worth, TX (2061); The Boeing Company, Seattle, WA (2568), McDonnell-Douglas Aircraft Corp of St. Louis, MO (2061, 2682), and Grumman Aircraft Corporation, Bethpage, NY (3391). Flight testing will be performed by Dryden Flight Research Facility and the Air Force Flight Test Center at Edwards AFB, CA. There are seven additional contracts with a total contract value of $6.4 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 2061, Attack Technology. This project integrates, at a system level, multiple fighter technologies provided by PE 63205F. These technologies include propulsion controls, avionic sensors, flight control, fire control, structures, and pilot/vehicle interface. Integration of technologies for flight test leads to confidence in higher system performance levels through the synergistic combination of subsystems. Performance improvements are validated in realistic piloted simulations and as well as flight test. The principal program in this project is Integrated Control and Avionics for Air Superiority (ICAAS). The ICAAS program emphasizes the need for functional integration between the primary elements of a fighter aircraft weapon system, including: (1) target/threat sensors; (2) fire control; (3) flight control; (4) weapons, and (5) pilot interface, for killing and surviving when outnumbered in air combat. The program addresses the engagement phase of the air-to-air mission integrating improvements in pilot situation awareness, beyond-visual-range (BVR) attack, effective transition to within-visual-range attack, threat missile evasion, and cooperative tasking (internetting) among friendly aircraft. Decision and control aids will be developed to help the pilot attack his targets. These aids will maximize weapon launch opportunities and minimize exposure to threats. Guidance information will be presented to the pilot for avoiding/evading threat missiles. As speed is a key to survivability, flight control software will maintain maximum aircraft performance throughout the engagement. Integrated information presented in the cockpit will enhance pilot situation awareness and allow the pilot to make better decisions. The ICAAS contractor will incorporate software from the associated Air-to-Air Attack Management (AAAM) program, in PE 63203F, which will develop algorithms that perform target detection, track, and identification functions from onboard and internetted fighter sensors. Radar tracks of the enemy will he used to compute whose targets are whose and threat missile launch envelopes, while decision aids provide the pilot recommended target priorities and engagement

data. Fire control software will enable missile launch against multiple Beyond Visual Range (BVR) threats using active or passive sensor modes. Air-to-Air Attack Management (AAAM) software will be subjected to piloted simulation evaluation and transitioned to Integrated Control and Avionics for Air Superiority (ICAAS) for system integration. Integration of offensive and defensive algorithms is expected to yield synergistic performance improvements. For example, attack will be executed with defensive contingencies in mind, and defense will be implemented so as to not abandon an offensive posture. Use of countermeasures in conjunction with missile evasion maneuvers will enhance probability of survival. Integrated information presentation in the cockpit will help the pilot handle simultaneous events which occur when engaging multiple targets. Ada language, a universally agreed upon computer language, will be used for all software development to assure maximum commonality and transferability to future and existing systems. In FY 1986, Integrated Flight/Fire Control (IFFC) software was recoded in Ada software, integrated with Ada flight control software and flight tested on an F-15 aircraft. This coupled gyroscopes and accelerometers formerly used for flight control, fire control and navigation, saving weight and reducing complexity. Contracts will be awarded in FY 1987 for development of AAAM and ICAAS software, preliminary to design of the pilot/vehicle interface. During FY 1988 this project will define a concept for a fighter aircraft subsystem that improves our ability to fight in air-to-air combat. The process of defining the concept includes the identification of tasks the system must carry out, a preliminary determination of the hardware needed to implement the system, and an initial cut at the mathematical equations and algorithms to be developed that will permit aircraft and sensor data processing and, where necessary, task automation. The FY 1988 activity will concentrate on the conceptual definition of these functions by specifying the mathematical equations and algorithms needed, the software needed to mechanize the algorithms, the hardware needed to implement the total system, and the aircraft modification required to carry out flight testing of the final design later in the program. During FY 1989, work will center primarily around the development of software and preparation of specifications for both simulation and aircraft hardware and computer requirements. Software development will proceed through several stages, beginning with a definition of the major sub-programs needed and the strategy to be used to tie them all together. At first, each of the functions described above will be dealt with on an individual basis. This will permit verification of each component's proper operation prior to any software integration activity. As software is coded and sub-routines completed, de-bugging and validation will take place for flight testing. In addition, computer specifications will be generated based on emerging software requirements and aircraft size and weight constraints. Finally, simulation requirements and associated specifications will be developed. This will provide ground based software and hardware to pre-screen system concepts prior to flight testing. During FY 1990, 1991, and 1992, hardware-in-the-loop simulation will be used to integrate hardware and software. The testbed aircraft will be modified, ground tested at the contractors' facility, and flight tested at the Air Force Flight Test Center in a realistic multi-target environment. Piloted simulations of combat engagements involving four internetted Integration of Control Avionics for Air Superiority blue fighters will be used to assess whether the goal of ten to one exchange ratio was achieved.

B. (U) Project: 2568, Mission Adaptive Wing (MAW). In conjunction with NASA, this program is flight validating the aerodynamic payoff of integrating variable camber (wing shape) into a smooth skin wing (no flaps or ailerons). By optimizing the wing shape for the flight condition (cruising, turning, landing, etc.), range, turning rate, ride quality, and alleviation of wing loads can be improved. For example, compared to a standard F-111, an aircraft with a MAW would reduce fuel consumption by 30 percent. These benefits can be applied to all categories of aircraft. In FY 1986 the first flight of the MAW occurred (18 October 1985). The wing is performing better than expected. The drag

is lower and the lift higher than predicted. The automatic control system will be installed and flight test will continue through FY 1987. In FY 1988 the program will be completed and a technical analysis of the available flight test data will be released for application to the Advanced Tactical Fighter (ATF) and other planned aerospsce vehicles.

C. (U) Project: 2979, Reliability/Maintainability for Flight Technology Integration. This project integrates and flight validates technologies developed under PE 63205F for a Self-Repairing Flight Control System (SRFCS) consisting of reconfigurable flight controls and artificially intelligent maintenance diagnostics. SRFCS will cut flight control system maintenance to one-seventh of what it is today, increasing aircraft availability and warfighting capability. Using the inherent redundancy in the suite of flight control surfaces (ailerons, stabilators, etc.) instead of redundant surface control equipment (servoactuators, hydraulics, etc.), SRFCS will reduce surface control design complexity by up to 75 percent. When a component (actuation control) fails, the SRFCS will automatically reconfigure the remaining flight control system components in order to maintain safe, although gracefully degraded, flight. Automatic reconfiguration is estimated to be four times safer than today's system based on redundancy. To aid flight line maintenance, the defective component is identified by the Artificial Intelligence (AI) diagnostic system, along with the component failure effects on the aircraft and impact on mission/safety requirements. In combat the system will reconfigure around battle damage and notify the pilot of the remaining flight control capability. The SRFCS will attempt to restore full control and monitor any further damage. In absence of full control, residual control authority will be maximized to allow return to base, or stabilize the aircraft long enough for a successful crew escape. In FY 1986, competitive contracts defined the preliminary influences that reconfiguration can have on a next generation fighter aircraft design. Down selection was made to one contractor to conduct an in-depth flight control system architecture design and aircraft control structure sizing, based on reconfiguration strategy capabilities. A preliminary study was completed on the data required and formats for informing the pilot of his degraded aircraft capabilities following reconfiguration. A preliminary reconfiguration effectiveness versus cost model was delivered and operated to assess the return on investment. In FY 1987, the engineering design will be initiated to add reconfiguration with embedded diagnostics and positive pilot alert to the flight control system, capable of compensating for a single surface failure. Intermediate results of a detailed reconfigurable flight control system design, with trade-off analyses of architecture and control structure sizing, will be available. A design of an on-board expert diagnostic system will be completed and readied for testing. In FY 1988, the hardware and software development for flight testing will be underway. A trade study of reconfigurable flight control system design for the next next generation of aircraft will be completed integrating the results of the flight testing. In FY 1989, the initial flight tests for a single surface impairment will be conducted. A complete ground-based sensitivity trade study and interaction of other automatic modes will be completed. Design criteria for developing the Self-Repairing Flight Control System (SRFCS) for the next generation fighter will be delivered. Completion of the design criteria with validation through flight testing in FY 1989 is critical to its incorporation in the ATF. The engineering design for a complete multi-axis SRFCS flight test will be initiated. During FY 1990-1992, the development and checkout of the multi-axis SRFCS will be completed and flight testing initiated. Demonstration of the SRFCS and update of the design criteria will be completed in early FY 1993. Note: Development of subcomponents and individual technologies is provided by PE 63205F, while PE 63245F provides system-wide integration and flight test.

Program Element: 63245F Title: Advanced Flight Technology Integration (AFTI)
DOD Mission Area: 523 - Engineering Technology (ED) Budget Activity: 2 - Advanced Technology Development

D. (U) Project: 3391, X-29 Advanced Technology Demonstrator. This project develops, integrates, and flight validates advanced aerodynamic, structural, and flight-control technologies of a forward swept wing aircraft that will provide design options for future military aircraft. Technologies include an aeroelastically tailored forward swept wing using composite wing box covers, discrete variable wing camber, relaxed static stability, and digital fly-by-wire flight controls with full-authority close-coupled canards and three-surface pitch control. The Air Force is extending the work begun under a Defense Advanced Research Projects Agency (DARPA)-funded and managed program (PE 62711E) that concluded in FY 1986. This project will transition these technologies to advanced development in order to evaluate their military utility and investigate high angle-of-attack (AOA) flight characteristics of forward swept wing aircraft. In FY 1987/1988 upgraded flight test instrumentation (required for high AOA testing) and a spin chute will be installed on the X-29 aircraft. Extensive computer simulation of flight controls will be conducted. Ground tests will be conducted to check out all aircraft systems, and flight testing will begin. Flight testing will continue through FY 1989. Funding requirements are based on both program office analysis and detailed contractor estimates (Cost categories III, Budgeting and IV, Planning).

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2682, Short Takeoff and Landing Maneuver Technology Demonstrator (STOL/MTD)

A. (U) Project Description: This project integrates and flight validates on a modified F-15, two-dimensional thrust vectoring/reversing nozzles, flight/propulsion controls, aircraft braking, and pilot/vehicle interface technology developed by PE 63205F. These technologies will produce an aircraft that can: (a) be controlled at any altitude airspeed or attitude by vectoring the thrust-system thereby outperforming any solely aerodynamically configured aircraft (b) use vectored propulsion in flight to reduce fuel consumption caused by aerodynamic drag thereby increasing range up to 15 percent; (c) control percent of thrust required while maintaining constant engine speed, providing in-flight thrust reversing and improved energy management during combat, takeoff/landing, and cruise; (d) takeoff and land on an icy runway, only 1500 feet long by 50 feet wide, in up to a 30-knot crosswind without the aid of ground support such as an instrument landing system. This circumvents runway denial tactics and/or allows dispersion to austere bases. Note: Funding for subcomponents and individual technologies is provided by PE 63205F while PE 63245F provides funding for system-wide integration and flight test.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: On-board simulation/training software requirements were integrated, and pilot-in-the-loop evaluations initiated. Modification of a test configuration F-15 began. Integration of the flight/propulsion control software was validated on a simulator. Brassboard flight control system computers were completed. Control laws (including nozzle controls) using advanced control system synthesis techniques were developed, providing new ways for a pilot to fly an airplane with the unique capabilities of the Short Takeoff and Landing/Maneuver Technology Demonstrator (STOL/MTD). Display formats also were developed, with emphasis on integration with pilot tasking in order to lower workload. New microchips (MIL-STD 1750) were used for the first time in a primary flight control system along with multi-level data processing techniques. Ada software was evaluated and used in the development of

software for nozzle control. The *STOL/MTD* computer based trainer/simulator has shown that on an average day the airplane maybe able to takeoff and land in less than 700 feet with a combat load onboard.

(2) (U) FY 1987 Program: Flight control system hardware will be flight qualified. Strategies to control system-wide hydraulic requirements, without affecting handling qualities, will be evaluated to reduce the weight and complexity of the hydraulic system by using advanced control law techniques. Development of software for the flight control system will begin. This is particularly important because STOL/MTD will have no flight control backup system-another first in reducing system complexity. New control strategies will be evaluated in flight simulators. Hardware and software integration of the flight controls, nozzle, and engine controller will be accomplished.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The STOL/MTD capabilities will be validated for application to the Advanced Tactical Fighter (ATF). By March 1988, the modified F-15 aircraft will have completed ground certification and be ready for its first flight. This includes: (1) completion of ground testing of the engines equipped with two-dimensional thrust vectoring and reversing nozzles, thrust stand, wind tunnel, and accelerated mission testing; (2) completion of aircraft modifications to incorporate engines and new nozzles, flight control and nozzle controllers, plus modified central computer, modified landing gear, upgraded cockpit displays, canards and new technology actuators; (3) inspection for Air Force acceptance of the STOL/MTD aircraft; (4) performance of hardware-in-the-loop simulations using actual flight control computers to verify hardware/software integrity; (5) completion of on-aircraft ground testing to verify functional integration of the new technology components; and (6) accomplish reviews necessary for flight clearance of the aircraft. The first flight planned for late March 1988. The validation and, modification, if necessary, of the pilot/vehicle interface and flight/propulsion control software will be conducted to demonstrate improved rough/soft field landing gear capability for the F-15 and to demonstrate a STOL capability is compatible with high performance fighter designs. The costs for FY 1988 are based on actual contract requirements (Category II, Mature).

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Phase I flight tests will be completed in FY 1989. During this year the program will: (1) complete the flight testing to quantify the benefits of the control system in all mission phases; (2) validate the application of modern control theory and multiple input/multiple output control systems to enable Short Takeoff and Landing (STOL) performance for high speed fighters; (3) demonstrate the feasibility of using on-board sensors for precise landing in low visibility and adverse weather as a routine operational capability; (4) quantify flying qualities test results and initiate any necessary changes to government flying qualities specification, and (5) prepare final program documentation and transition the technology to industry and appropriate government agencies. This includes data on specific mission profiles, i.e., air-to-air, training, ferry, etc., to provide first order reliability and maintainability data on integrated flight propulsion controls. Final reports documenting the test results will be written. The costs for FY 1989 are based on actual contract requirements (Category II, Mature) and Air Force Flight Test Center Statement of Capability.

(5) (U) Program to Completion: This is a continuing program. Projects will complete design, fabrication, modification, integration, and ground/flight test of the F-15 Short Takeoff and Landing/Maneuver Technology Demonstrator (STOL/MTD). The aircraft may subsequently be used to demonstrate the benefits of vectored thrust in controlling

aircraft during combat. Full up-and-away integration flight and propulsion controls will allow post-stall control and eliminate the minimum control airspeed versus maximum airspeed problems of very high altitude flight.

C. (U) Major Milestones: Not applicable.

9. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3417, Boost Glide Vehicle Demonstration (BGV)

A. (U) Project Description: Component technologies developed in PEs 63205F, 63203F, and 63211F, for the Boost Glide Vehicle, will be integrated and flight tested. Flight controls, guidance, structures, and aerodynamics will be proven. BGV combines the emerging technologies of structural carbon-carbon materials (which makes possible a high efficiency, lightweight aerodynamic design) and a ring laser guidance (for autonomous flight control) into an unmanned hypersonic delivery system. The benefits to be flight demonstrated are: (1) that the BGV can have twice the range of conventional ballistic systems for a given size launcher and take only a fraction of an hour to reach a target area; (2) assessment of inherent thermal and structural hardness, transcontinental targeting footprint and high-g terminal maneuver capability, to gain survivability well into the next century; (3) demonstration of the aerodynamic, structural and flight control technologies needed to design high performance hypersonic manned vehicles. Note that funding for subcomponents and individual technologies is provided by PEs 63205F, 63203F, and 63211F while PE 63245F provides funding for system-wide integration and flight test.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: The Advanced Development Program Office (ADPO) was formed in December 1985. In 1986 the ADPO prepared the draft statement of work, and completed the draft request for proposals (RFP). Further work progressed on developing a business strategy.

(2) (U) FY 1987 Program: The flight demonstration program request for proposal will be released in April 1987. In parallel, studies of mission analysis and planning will begin.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: A single contractor will be selected in the first quarter of FY 1988. This contractor will lead a test team to develop the experimental flight test vehicle. Preliminary design on Boost Glide Vehicle (BGV) flight vehicle and test launcher modification will proceed under separate contracts. Long lead materials and flight test sensors will be ordered. The contractor will begin subscale testing of structural design concepts and develop subcomponent test plans. Range Support and Range Safety planning will begin. Preliminary Design Review occurs nine months after contract award. Testing of scaled candidate configurations and full scale components will precede final configuration selection. Approximately three months after prime contract award, extensive wind tunnel testing will begin. FY 1988 testing will include force and moment, heat transfer, and pressure and loads testing of a 30% scale model BGV at Arnold Engineering and Development Center (AEDC). Further testing will be conducted at contractor facilities to include higher Mach number tests on both the BGV and the test

launch booster combination. Materials and thermo-structural testing will be conducted at NASA Ames, the Air Force Wright Aeronautics Laboratories test facility, and contractor. Detailed test planning will be completed and modification to flight test boosters (Minuteman I) and launch facilities will begin. Aerodynamic heating tests and gasdynamics analysis will be conducted and analyzed. Aerodynamic wind tunnel testing begun in FY 1987 will be concluded in FY 1988. A booster launch service contract will be awarded. Long lead items will be ordered to allow assembly of complete Minuteman I systems for the flight test. Further subcontracts for guidance and control modification will be awarded.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Contractor will continue subscale configuration and subcomponent testing. Final design will be frozen at Critical Design Review (CDR) 18 months after contract award. Fabrication will begin on the five flight test vehicles. Ground testing of components, subsystems, and scale models will continue after refinements resulting from Preliminary Design Review are incorporated. Arnold Engineering and Development Center (AEDC) testing on 30% Boost Glide Vehicle (BGV) scale model and Booster/BGV model configuration testing will also be completed. Carbon/carbon airframe fabrication will be carried out on a component basis by speciality materials fabricators. The prime contractor will assemble final components. Fabrication of the initial two airframes will be started in late FY 1989. One will be a structural test article. Subsystem installation will be completed in the second airframe (the first to fly), and installation will begin on the partially completed third airframe. Functional in-factory checks will be started with the second airframe and its assembled subsystems. Preparations will be carried out to statically test the first airframe at high temperatures. Booster fabrication will commence through Ballistic Missile Office using the launch services contract. Booster interstage and shroud development and fabrication will continue. Aerodynamic heating and gas dynamics studies will be completed. Necessary modifications to the launch site will commence. Range support at the Western Space and Missile Center will continue, with detailed safety analysis, flight trajectory planning and refinement, and launch operations preparation. The first flight booster will be completed at the end of the year.

(5) (U) Program to Completion: This is a continuing program. All efforts will continue, leading to the first BGV flight test vehicle delivery to the government in February 1992. After systems checkout and integration, first flight will occur in April 1992, with three succeeding flights at six month intervals. After completion of the flight test program, all results will be analyzed and compared to wind tunnel, ground test, and computer computational fluid dynamics results. A FY 1992-1994 flight test program to validate the component technologies developed under PE 63205F is essential to meet the Strategic Air Command requirements. Cost estimates are based on Air Force historical data, a request for information from five contractors, and an internal Air Force cost estimate.

NOTE: As in all activities in this PE, the end result described is not possible without the support and full cooperation of several PE's.

C. (U) Major Milestones: Not applicable.

10. (U) COOPERATIVE AGREEMENTS: Not applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63248F
DOD Mission Area: 553 - Engineering Technology (ATD)

Title: Concept Development
Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		5,869	4,969*	4,785	6,259	Continuing	N/A

* Reflects reprogramming of $3,999M in FY 87

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The normal planning, programming, and budgeting system (PPBS) provides an effective method to transition technology through exploratory development into system acquisition. However, in a limited set of cases (i.e., technological breakthrough, exploitation of enemy weaknesses, alternate use of existing technologies, etc.), the PPBS does not have the flexibility to capitalize on these opportunities on a timely basis. To address this problem, the Commander of Air Force Systems Command has established an office of New Concepts and Initiatives (NCI) to solicit innovative ideas from all sources and act as a clearing house to determine and implement appropriate actions. Working with using commands and Headquarters United States Air Force, the NCI office assesses the military worth of concepts and recommends one of the following dispositions (a) rejection, (b) referral, (c) reorientation of existing programs, or (d) acceptance as an NCI for a feasibility demonstration. In the formulation of efforts and demonstrations, the Concept Development program element is building toward a $5.0 million/year "level-of-effort" (constant FY 1983 dollars). In previous fiscal years this level has proven to be the amount necessary to promulgate an effective NCI program.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	2,000	3,214	4,881	N/A	Continuing	N/A

EXPLANATION:

(U) FY 1986: Funds appropriated were augmented by $3,869 thousand within threshold reprogramming. The additional funding was used to fund the FY 1986 increment of the Air Force's Project FORECAST II.

(U) FY 1987: Reflects Congressional action and reprogramming of $3,999 thousand within threshold reprogramming. The additional funding was used for the FY 1987 increments of ongoing NCI programs and initiation of a limited number of FY 1987 NCI efforts.

4. (U) OTHER APPROPRIATION FUNDS: Not applicable.

5. (U) RELATED ACTIVITIES: The NCI program is structured to capitalize on innovative concepts as they occur across a wide range of technology areas. Successful new concept demonstrations are usually transitioned into established advanced

technology programs or directly into engineering development/system m[illegible]ifications. A 3.5 to 1 "leverage" on these funds has been realized from other funding sources (e.g., other services, agencies, etc.).

6. (U) WORK PERFORMED BY: Concept Action Teams are formed at Air Force Systems Command product divisions and laboratories, with participation of user commands, to review and manage NCIs in response to direction from the NCI office. Validation demonstrations are primarily contracted out and account for the bulk of the funds in the Concept Development program element. Currently, the top five contractors are: IBM (HAVE BID), Owego NY; Syracuse Research Laboratory (HAVE BID), Syracuse NY; Hughes Aircraft Company (HAVE FANG), Los Angeles, CA; E-Systems (Rapid Application of Airpower), Dallas TX; Sandia Laboratories (HAVE PULSE), Albuquerque, NM.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: PE 63248F, Concept Development

A. (U) Project Description: Most New Concepts and Initiatives (NCI) efforts will be incrementally funded over a one-to-three year span, usually at a total cost of less than $3 million. Although roughly half of the FY 1988 and/or FY 1989 funds in this program element will be reserved to capitalize on new concepts which emerge during the fiscal year, specific initiatives currently in progress/programmed for FY 1988 and/or FY 1989 will be continued.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Demonstration of an airborne laser communications system was successfully completed. A feasibility demonstration of developing and applying "dynamic profiles" of classical enemy maneuvers in an artificial intelligence-based decision aid was started. Demonstration of Phased Integrated Laser Optics Technology is ongoing. The High Power Microwave, Inertially Aided Munitions, and Enhanced Heads-Up Display programs were initiated in FY 1986.

(2) (U) FY 1987 Program: Transfer alignment testing of the Inertially Aided Munitions will be conducted. Analysis for a prototype design for the Enhanced Heads-Up Display will be completed. The Passive Noncooperative Identification (HAVE BID) test will be completed and the program will be transitioned into the Atmospheric Surveillance Technology program. Programs anticipated for initiation in FY 1987 that will have continuing funding requirements in 1988 are: evaluation of situational awareness terminal for air-to-air combat, demonstration of an automated high frequency communications link for the Alaskan Air Command, high power microwaves, automatic target selection/cueing system, and two controlled need-to-know programs.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Programs initiated in FY 1987 will be continued. These include: flight testing of the inertially aided munitions, high power microwaves, operational evaluation of situational awareness terminal, and testing of the automatic target/cueing system. Other NCIs which arise during the year will be funded, as appropriate, from within resources reserved in the Concept Development program element and/or appropriated in directly related programs. The flexibility to respond/fund a small numer of carefully selected high payoff NCIs when they occur, as opposed to some years later when they can be budgeted for, is the essence of the NCI program.

Special attention is always given to limiting use of this process to only those innovative concepts which warrant accelerated support. Further, this support from the NCI process is used to achieve key demonstrations which facilitate transition of the concepts in the conventional programming processes.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Programs initiated in FY 1988 will be continued. These include: flight testing of the automatic target/cueing system and demonstration of passive non-cooperative identification using alternate application. Other NCIs which arise during the year will be funded, as appropriate, from within resources reserved in the Concept Development program element and/or appropriated in directly related programs.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones:

Milestone	Date
(1) (U) Inertial Guidance Technology Transfer Alignment	Sep 87
(2) (U) Situational Awareness Terminal Air-to-Ground Test	Oct 87
(3) (U) Situational Awareness Terminal Air-to-Air Test	Dec 87
(4) (U) Noncooperative ID Demonstration	Jan 88
(5) (U) Automatic Target/Cueing System Flight Test	Sep 88
(6) (U) Inertial Guidance Technology Flight Test	Nov 88

8. (U) PROJECTS OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not applicable.

9. (U) COOPERATIVE AGREEMENTS: Not applicable.

FY 1988/FY 1989 RDT&E DES PTIVE SUMMARY

Program Element: 63250F | Title: Lincoln Laboratory
DOD Mission Area: 551 - Electronic & Physical Sciences (ATD) | Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		25,703	18,841	24,760	26,655	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Lincoln Laboratory program is a high technology research and development effort conducted through the provisions of a cost reimbursement contract with Massachusetts Institute of Technology. Lincoln Laboratory is operated as a Federal Contract Research Center administered by the Department of Defense. This funding maintains a stable technology base in advanced electronics from which military systems may be developed. From this technology base, Lincoln Laboratory engages in advanced research and technology demonstration in the areas of military satellite communications, space radar technology, space-based visible surveillance, deep space surveillance, and tactical battlefield surveillance. Lincoln Laboratory also provides technical advice and consultation to the military services and defense agencies. This is a Science and Technology program.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	23,000	26,524	28,208	N/A	Continuing	N/A

EXPLANATION: (U) FY 1986: Funds added to maintain stable program.
(U) FY 1987: Reduced $3,524 by Congress and $4,159 for undistributed reductions. Reprogramming action in progress to restore to the $26,524 level requested in the FY 1987 President's Budget.
(U) FY 1988: Reduction to meet revised fiscal goals.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: Many of the efforts funded by this program element are carried out in conjunction with one or more of the following: Milstar, PE 33603F; Tactical Command, Control, and Communications Advanced Development PE 63789F; Command, Control, and Communications, PE 62702F; SPACETRACK, PE 12424F; Space Surveillance Technology, PE 63428F; Communications Security, PE 33401F; Defense Research Sciences, PE 61102F; Restructurable Very Large Scale Integration, PE 61101E (Defense Advanced Research Projects Agency (DARPA)); Wafer-Scale Integration, PE 62301E (DARPA); Laser Imaging Technology (Strategic Defense Initiative Office); and Advanced Communications Technology Satellite (National Aeronautics and Space Administration (NASA)).

Program Element: 63250F | Title: Lincoln Laboratory
DOD Mission Area: 551 - Electronic & Physical Sciences (ATD) | Budget Activity: 2 - Advanced Technology Development

6. (U) WORK PERFORMED BY: Lincoln Laboratory, Lexington, MA, is a special laboratory of the Massachusetts Institute of Technology under contract with the Air Force and is designated a Federal Contract Research Center. General policy and program guidance is provided by the Lincoln Laboratory Joint Advisory Committee in accordance with the provisions of the Department of Defense Plan for Administration of Lincoln Laboratory, dated 27 May 1975. The Lincoln Laboratory contract is administered by the Air Force Systems Command's Electronic Systems Division, Hanscom AFB, MA.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 63250F, Lincoln Laboratory.

A. (U) Project Description: Lincoln Laboratory was established in 1951 by the Air Force with participation by other agencies of the Department of Defense. The mission is to conduct research and development pertinent to national defense. The Lincoln program extends from fundamental investigations in science through the development of electronic devices and components to the design, development, and field demonstration of conceptual models containing the new technology. Lincoln's research activity encompasses work in military satellite communications, space radar technology, space-based visible surveillance, deep space surveillance, and tactical battlefield surveillance (radar and emitter location). Lincoln also provides technical advice and consultation to the military services and defense agencies.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: LASER COMMUNICATIONS (LASERCOM) TECHNOLOGY: Continued development of brassboard of LASERCOM flight package to be integrated on the National Aeronautics and Space Administration's Advanced Communications Technology Satellite. EXTREMELY HIGH FREQUENCY SATELLITE COMMUNICATIONS TECHNOLOGY: Continued development of prototype man-portable Milstar-compatible terminal. MILITARY SATELLITE COMMUNICATIONS SYSTEM ENGINEERING: Major contributions to Satellite Data Link Standards and Universal Modem programs; continued technology transfer to Milstar contractors. DIGITAL INTEGRATED CIRCUITS PROGRAM: Successfully demonstrated customized wafer scale technology; successfully tested a new diode link technique which is compatible with standard metal-oxide-semiconductor processing; transferred Lincoln radiation-hardening technology (up to 10^6 rads) to Sandia Laboratory. SOLID-STATE TECHNOLOGY: Fabricated gallium-arsenide permeable-base transistors with maximum frequency of oscillation of over 200 GHz and switching risetime of 5 picoseconds, representing record high-frequency performance for transitors; demonstrated total-dose radiation hardness of up to 10^8 rads for complementary-junction field-effect transistors fabricated in silicon-on-insulator films; achieved record-high sensitivity in resonant-optical-cavity infrared heterodyne photomixer arrays; demonstrated gallium-arsenide (GaAs)/ aluminum-GaAs quantum well charge-coupled devices (CCDs) for use in spatial light modulators for optical signal processing. SPACE RADAR TECHNOLOGY: Initiated assembly of low sidelobe test array; demonstrated >50 dB adaptive nulling capability in a ground test receiver, a 25 dB improvement. SPACE-BASED VISIBLE TECHNOLOGY: Design of three-sided buttable, back-illuminated arrays using 1,000,000

pixels was completed; completed design of charge-coupled device (CCD) imager test devices with built-in on-chip processing which will provide a pixel processing rate reduction of 1,000. INFRARED AIRBORNE RADAR: Infrared Radar tested successfully against ground targets in range, passive and Doppler-velocity detection modes; tactical targets as well as Pershing missile complexes have been measured. TACTICAL BATTLEFIELD SURVEILLANCE: Continued development of a high-speed, very compact signal and data processor for use in ground and airborne radars; programmable processing capacity of 100 million operations per second was realized in a 1.25 cu.ft., 50-lb package; a major achievement in low frequency emitter location capability, featuring modern adaptive array spatial signal processing, was demonstrated in scale model tests, and full-scale flight tests were commenced.

(2) (U) FY 1987 Program: LASER COMMUNICATIONS (LASERCOM) TECHNOLOGY: Develop prototype of LASERCOM flight package to be integrated on the National Aeronautics and Space Administration's Advanced Communications Technology Satellite (ACTS). EXTREMELY HIGH FREQUENCY (EHF) SATELLITE COMMUNICATIONS TECHNOLOGY: Complete development of prototype man-portable Milstar-compatible terminal and test with in-orbit Fleet Satellite EHF Package. MILITARY SATELLITE COMMUNICATIONS SYSTEM ENGINEERING: Continue contributions to Satellite Data Link Standards program and continue Milstar technology transfer. DIGITAL INTEGRATED CIRCUITS PROGRAM: Develop 4" wafer-scale integrated circuits with reduced-size diode links; design and fabricate million-plus transistor systems for image processing applications. SOLID-STATE TECHNOLOGY: Develop EHF discrete and monolithic amplifiers and wide-bandwidth sample-and-hold circuits using gallium-arsenide (GaAs) permeable-based transistors; explore high-frequency field-effect transistors to exploit the high electron velocities in indium phosphide and gallium-indium arsenide; develop chemical-vapor-deposition techniques for fabricating electro-optic devices and large-area monolithic diode laser arrays; explore high-throughput image processing in focal-plane CCDs. SPACE RADAR TECHNOLOGY: Initiate installation of versatile near-field test range; demonstrate 50 dB sidelobe nulling with 4-channel receiver and low-sidelobe antenna; fabricate systolic arrays for jamming/clutter processing; develop high quality low-noise amplifiers and fiber optics for transmit modules; develop wideband nulling algorithms; continue exploration of cross-section target detection techniques. SPACE-BASED VISIBLE TECHNOLOGY: Continue development of advanced CCD imagers and CCD devices with on-chip processing. INFRARED AIRBORNE RADAR: Infrared Airborne Radar will be flight tested in a full active/passive mode; development will be initiated on a neural network processor for the radar. TACTICAL BATTLEFIELD SURVEILLANCE: The compact, high-speed signal and data processor will be exercised in an airborne, captive-carry fashion as part of a mini-remotely-piloted vehicle radar demonstration; full-scale flight tests of the advanced adaptive array emitter location systems will be completed.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The basic thrusts in satellite communications will be continued. The effort on the LASERCOM package for ACTS will be at its peak. System engineering efforts will focus on Defense Satellite Communications System-III follow-on wideband applications. Development of wafer-scale integrated circuits for processing focal plan array signals for electro-optic surveillance applications will begin. Fabrication and testing of radiation-hard wafer-scale integrated circuits based on Lincoln developed silicon-on-insulator and rad-hard gate technologies will be initiated. Development of extremely high frequency (EHF) power permeable-base transistors (PBTs) and monolithic integrated circuits incorporating PBTs will begin. Development of high-frequency indium phosphide and gallium-indium arsenide field-effect transistors will begin. Demonstration of

high-speed optical interconnect techniques using monolithic gallium-arsenide(GaAs)-on-silicon structures will proceed. Space radar efforts will be concentrated on completion of a near-field test range, and continuation of advanced adaptive nulling demonstrations. The development of various charge-coupled device (CCD) imagers will continue, with the technology demonstrated using experimental electro-optical sensors in the laboratory and field-site testing. The Infrared Airborne Radar will be flown against a variety of targets and backgrounds. Target detection and false alarm statistics will be developed. Multi-dimensional data will be tested for target recognition on an off-line neural learning machine. Development of a real-time processor for in-flight testing will be initiated. Wafer-scale chips and neural network processors on silicon will be tested. Free-flight tests of the remotely piloted vehicle radar system will take place. An advanced version of the signal-data processor should realize a capacity of 150 million operations per second in a 30-lb, 1-cubic-ft package. Refined emitter location algorithms will be developed, based on the results of the flight program. This is a technology development program and planning cost estimates are based on engineering judgements and comparision with similar technology development efforts.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The Laser Communications flight package will be integrated onto the Advanced Communications Technology Satellite and subjected to integrated system testing; the ground terminal will be nearing completion. The architectural features of the future wideband system will have evolved and the design of prototype hardware can begin. Demonstration of the wafer-scale focal plane processor for electro-optic surveillance applications will begin. Development of a radiation-hard focal-plane processor will be initiated. Extremely High Frequency (EHF) power permeable-based transistors (PBT) will be improved and fabrication of more complex monolithic integrated circuits incorporating PBTs will begin. Sensitivity of CCD imagers will be improved by introducing avalanche gain in the CCDs to overcome the noise of the charge-sensing circuit. Monolithic integration of very-large-scale-integration silicon circuits and high-speed gallium-arsenide (GaAs) circuits will be undertaken. Advanced space radar transmit/receive module component development will be explored. Development of fiber optics devices for light-weight phased-array power distribution and wafer-scale integration of systolic array configurations for high throughput signal processing requirements will also begin. New medium-wave infrared detector arrays to provide improved performance will be developed. Technology demonstrations using experimental electro-optical sensors in laboratory and field-site testing will be pursued. Flight testing of the infrared airborne radar with an on-board real-time processor will be undertaken. Testing of autonomous acquisition and identification techniques against a variety of tactical targets for aircraft ground attack and smart weapon application will proceed. Improved radar capabilities (doppler beam sharpening) will be added to the remotely piloted vehicle radar. Development of new emitter location algorithms that can cope with advanced signal formats will be initiated. This is a technology development program and planning cost estimates are based on engineering judgements and comparison with similar technology development efforts.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63253F Title: Advanced Avionics Integration
DOD Mission Area: 551 - Electronic and Physical Sciences(ATD) Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual *****	FY 1987 Estimate *****	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		2,761	3,891	16,676	15,042	Continuing	N/A
665A	Reconnaissance Sensors/ Processing Technology	**** 2,761	0	0	0		
666A	Advanced Reference Systems Development	0*	1,770	1,800	1,700	Continuing	N/A
2345	Airborne Imagery Transmission System	0**	172	Transfer to PE 63203F		N/A	N/A
2735	Advanced Systems Avionics Applications	0***	1,089	1,192	1,109	Continuing	N/A
2746	Low Probability of Intercept Communications	0**	860	Transfer to PE 63203F		N/A	N/A
2733	Advanced Reconnaisance/ Strike Radars	0*	0*	13,684	12,233	Continuing	N/A

*Funding in PE 63203F
**Funding in PE 63727F
***Funding in PE 63109F
****Funding in PE 63208
*****Prior years reflect FY 1988 Science and Technology restructuring for comparability purposes only.

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Avionics systems are increasingly moving towards integrated, modular, multi-purpose systems and away from single function "black boxes". As new capabilities are developed in response to operational requirements, these capabilities can now be added as new functions to existing modular avionics systems in many cases. Even if adding a new capability through a new stand alone system is the most economical path, this new system must still interact extensively with many other avionics systems and capabilities aboard the aircraft. The main thrust of this program element is to develop new avionics capabilities through the proof of concept stage with the intent of adding these capabilities to our aircraft by adding a new function to existing modular integrated avionics where possible, or functionally integrated with those avionics where a new stand alone system is required. The development and testing of new capabilities for our integrated avionics systems will greatly reduce size and weight,

Program Element: 63253F Title: Advancd Avionics Integration
DOD Mission Area: 551 - Electronic and Physical Sciences (ATD) Budget Activity: 2 - Advanced Technology Development

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
RDT&E	0	9,369	6,708	N/A	Continuing	N/A

EXPLANATION (U): FY 1987 reduction due to Congressional cuts. Addition in FY 1988 is due to the transfer of Project 2733 to this PE.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: PE 62204F, Project 2003, Avionics System Design Technology; PE 63743F, Project 2432, Integrated Electronic Warfare System; and PE 62204F, Project 6095, Inertial Reference and Guidance, and Project 7662, Avionics Data Transmission and Reception provide supporting technology for this program. PE 63226F, DOD Common Programming Language Advanced Development and PE 63728F, Advanced Computer Technology will provide Ada support software products for use by this program for application to avionics related software developments. Close coordination with the Defense Advanced Research Projects Agency sponsored Pilot's Associate Program is needed so that expert systems technology can be used to reduce crew workload. Close coordination between this program and PE 63601F, Project 670A, Ordnance Technology, will be maintained to insure successful implementation of MIL-STD-1760, Aircraft-to-Stores Interface. Close coordination with PE 63231F, Project 2829, Cockpit Automation Technology, will be maintained to insure appropriate use of new automation control and display concepts. PE 62204F Aerospace Avionics provides supporting exploratory development of solid state active aperture arrays for high reliability airborne radars to project 2733.

6. (U) WORK PERFORMED BY: Current efforts are being performed by Westinghouse Electric Company, Baltimore, MD; Rockwell International, Collins Radio Division, Cedar Rapids, IA; Hughes Aircraft Co, Los Angeles, CA; TRW Incorporated, San Diego, CA; International Business Machines, Manassas, VA; and Texas Instruments, Dallas, TX. The in-house organization responsible for the program is the System Avionics Division, Avionics Laboratory, Wright-Patterson Air Force Base, OH.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 666A, Advanced Reference Systems Development. This project will provide sensors, integration techniques and systems to improve the accuracy and availability of navigation and reference information for future weapon delivery systems. The objective of the technology developments will be to improve the availability and capabilities of tactical aircraft, strategic aircraft and cruise missiles to operate in an autonomous mode for global all-weather strikes. Major technology thrusts are in the areas of inertial and radio navigation components and systems integration with emphasis on increased performance, reliability and reduced life cycle costs. An Integrated Inertial Reference Assembly (IIRA) will be developed by this project in conjunction with and as part of

PAVE SPRINTER (PE 63109F). The IIRA effort seeks to reduce by two-thirds the number of inertial sensors required on fighters, increase mean-time-between-failure (MTBF) to 2000 hours and decrease maintenance costs. The joint Air Force/Navy development of a high accuracy ring-laser-gyro (RLG) to increase cruise missile strike capabilities and provide motion compensation advanced sensors is a second major navigation effort. In FY 1986 the program continued development of a high accuracy ring-laser-gyro (RLG) Inertial Navigation System (INS); initiated procurement for the development of an Integrated Inertial Reference Assembly (IIRA) capable of supporting all aircraft inertial reference system requirements and conforming to specifications of size and weight defined by AF Standard INS; expanded previous developed adaptive multifunction antenna technology to accommodate voice and reduced sign apertures aspects. The FY 1987 program continues development of a High Accuracy RLG Brassboard INS initiates IIRA design and development. The FY 1988 planned program completes High Accuracy RLG Brassboard INS flight test and evaluation; continues development/fabrication of the IIRA thru Critical Design Review with two contractors and the fault tolerant INS (FTINS) of IIRA as part of the PAVE SPRINTER program. The FY 1989 planned program completes development and integration of the FTINS in the test bed concept and supports the test program and initiates reference system technology development for hyper-velocity vehicles. In FY 1990 IIRA fabrication will be complete and flight test evaluation initiated; continues exploratory development transition of artificial intelligence techniques for navigation. Funding requirements are based upon the cost of contracts for similar technology efforts and are category IV, Planning.

B. (U) Project: 2735, Advanced Systems Avionics Applications. This project provides for proof of concept simulator testing and flight testing of advanced integrated avionics concepts. As the various advanced avionics projects develop hardware and software to achieve new capabilities, it is integrated through this project into ground-based laboratory simulators or into test bed aircraft along with other operational or developmental avionics systems to investigate fully both the new system's performance and capabilities, and its interactions with the other systems in achieving a total aircraft system capability. The FY 1986 program continued this PAVE SPRINTER test preparation, initiated the Survivable Penetration and Attack (SPA) program which will add threat avoidance to the Terrain Following/Terrain Avoidance effort, and initiated the PAVE CAP investigation into applying artificial intelligence (AI)/expert systems to aid pilots in a combat environment. The FY 1987 and FY 1988 programs include continuing the SPA effort and PAVE SPRINTER flight test planning and continuing the PAVE CAP studies of AI applications to fighter aircraft avionics. In FY 1989 aircraft integration of promising SPA and PAVE CAP concepts begins. In FY 1990 and beyond the program integrates promising concepts, flight tests them, and further refines the concepts based upon the flight test results. Funding estimates are initial estimates based upon the costs of other laboratory efforts and are Category IV, Planning.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2733, Advanced Reconnaissance/Strike Radars

A. (U) Project Description: This project develops and demonstrates new radar system capabilities addressing Air Force requirements. The major radar technology objectives of this project address: (1) an in-weather capability for detection, acquisition, location, and strike against fixed, stationary and moving tactical size targets; (2) a multiple target detection, track and launch capability; and (3) improved reliability, availability and maintainability at reduced acquisition and life cycle costs. These developments also include requirements for reduced emissions

and Electronic Counter-Countermeasures techniques needed for system survival in the threat environment of the 1990s. The Ultra-Reliable Radar (URR) program is to improve airborne radar Mean-Time-Between-Failures by an order of magnitude over current radars. The URR effort will take advantage of the latest hardware technology developments (i.e., active array and Very High Speed Integrated Circuits) and integrate them into a fault-tolerant architecture which is self-healing thereby demonstrating graceful degradation and non-single point failure characteristics. The architecture will be manifest in line replaceable modules which are supportable by two levels of maintenance (flightline and depot) and which require no test equipment at the employment site. The URR will possess multimode capabilities allowing it to support both air-to-air and air-to-ground missions.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Initiated URR development. This project capitalizes on the Solid State Phased Array developed under Project 69CK, and the Very High Speed Integrated Circuit (VHSIC) technology Common Signal Processor (CSP) and 1750A Data Processor developments. The URR development will result in a multimode radar capable of air-to-air and air-to-ground missions against multiple targets and with an order of magnitude increase in radar system availability.

(2) (U) FY 1987 Program: Initiate Hardware fabrication and software implementation of URR and continue its development. Support development of VHSIC 1750A data processor and VHSIC CSP capable of processing radar, Electronic Warfare (EW), Electro-Optical, and Communications/Navigation signals.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Continue development of URR through final integration of the VHSIC 1750A data processor and CSP, solid state phased array antenna, and receiver/stalo assembly. Initiate URR rooftop test. Continue support of CSP development. Funding requirements are based upon the cost of contracts for similar technology efforts and are category II, mature. Initiate Air-to-Ground Automatic Target Acquisition (A/G Auto Tgt Acq) effort.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Continue development of URR through rooftop test. Software verification and validation as well as preflight ground tests will be accomplished. Continue support of CSP development. Continue support of A/G Auto Tgt Acq development. Funding requirements are based upon the costs of contracts for similar technology efforts and are category II, mature. Initiate Advanced Counter Low Observable development.

(5) (U) Program to Completion: Continue development of Ultra Reliable Radar (URR) through flight testing. Continue support of Air/Ground Automatic Target Acquisition. Continue support of Common Signal Processor developments. Continue support of Common Signal Processor development capitalizing on Very High Speed Integrated Circuit and capable of processing radar, Electronic Warfare, Electro-Optical, and Communication/Navigation signals. This is a continuing program.

C. (U) Major Milestones:

Program Element: 63253F Title: Advanced Avionics Integration
DOD Mission Area: 551 - Electronic and Physical Sciences (ATD) Budget Activity: 2 - Advanced Technology Development

Milestones		Dates
(1) (U) Complete radar human factors simulations		September 1983
(2) (U) Complete initial investigations of Low Probability of Intercept		March 1984
(3) (U) Initiate Air-to-Ground Auto Target Acquisition		September 1988
(4) (U) Complete Ultra Reliable Radar (URR) demonstration		September 1988
(5) (U) Initiate Advanced Counter Low Observable development		March 1989
(6) (U) Start URR flight demonstration	*(Sep 89)	March 1990
(7) (U) Complete URR flight demonstration	*(Sep 90)	June 1991
*Date presented in FY 1987 Descriptive Summary		September 1992

(U) Explanation of Milestone Changes:

(6) (7) (U) This change reflects delays in delivery of common signal processor and additional flight testing of the URR, with an associated later completion date.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63269F
DOD Mission Area: 553 - Engineering Technology (ATD)
Title: National Aerospace Plane (NASP) Technology Program
Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		0	0	236,039	306,288	1,939,666	2,481,993
3384	NASP Technology Program	0	0	236,039	306,288	1,939,666	2,481,993

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This is a Science and Technology effort. This program element funds the Department of Defense (DoD) portion of the joint DoD/National Aeronautics and Space Administration (NASA) technology development and demonstration program known as National Aerospace Plane. It continues work done under the Defense Advanced Research Projects Agency (DARPA) Copper Canyon program which is now referred to as Phase I of the NASP program. Currently the program is in Phase II; technology development, which will lead to Phase III, where an experimental vehicle will be fabricated and flight tested. The NASP program combines with funding commitments by DARPA, Navy, Strategic Defense Initiative Organization (SDIO) and NASA. It is a jointly managed Air Force, Navy, DARPA, SDIO, and program with all DOD funds consolidated in the Air Force for FY 1988 and beyond. This program investigates and develops propulsion, structures, and other critical technologies to enable development of a hypersonic aerospace vehicle, capable of delivering payloads into orbit. The NASP is envisioned to be an airbreathing, hydrogen fueled, single-stage-to-orbit horizontal takeoff and landing vehicle. If the technological assessment continues to be positive, the program will proceed to flight demonstration of an experimental research vehicle. These technologies and the results of flight testing will provide a basis for a new generation of aircraft and space launch vehicles to satisfy both military and civilian needs. Significant benefits of a future vehicle development program will be a highly responsive military aircraft, flexibly based, very low-cost space launch, and economical civil hypersonic transport. The Air Force has overall DOD program management responsibility with DARPA leading technology efforts for the current phase. In addition to technology investigation, initial efforts will include definition of military missions and design specifications such as survivability, payload requirements, and study of advanced technology applied to logistics areas such as reliability, maintenance, fuel processing and payload integration processing. This program provides information to the National Space Transportation Architecture Study.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	0	33,490	84,572	N/A	905,000	1,023,002

EXPLANATION: (U) The significant increase in Air Force funding reflects a consolidation of the Total Obligation Authority of DARPA, SDIO, and the Navy in the Air Force line for FY 1988-1994. The Congress appropriated all FY 1987 DoD funds in DARPA and SDIO.

4. (U) OTHER APPROPRIATION FUNDS: Not applicable.

5. (U) RELATED ACTIVITIES: This is a joint Department of Defense (DoD)/National Aeronautics and Space Administration (NASA) program. DOD program participants are the Air Force, Navy, Defense Advanced Research Projects Agency (DARPA), and Strategic Defense Initiative Organization (SDIO). The participation of the DoD organizations is governed by a Memorandum of Agreement, dated 25 April 1986, signed by all parties and by the Under Secretary of Defense for Research and Engineering. In FY 1987, NASP efforts will be conducted under PE 63269E, National Aerospace Plane Technology; and PE 63224C, SDI - Survivability, Lethality and Key Technologies. In FY 1988 and beyond, all DoD funding will be in PE 63269F. NASA participation with DoD is governed by a Memorandum of Understanding dated 29 July 1986 between the Secretary of Defense and the NASA Administrator.

6. (U) WORK PERFORMED BY: The Air Force is assigned overall DoD responsibility. DARPA, with the Air Force acting as executive agent, will manage the Phase II technology development effort (FY 1986-89) with participation by the Navy, SDIO and NASA. The Air Force will manage the Phase III vehicle fabrication and flight demonstration phase (FY 1989-94). A Joint Program Office, managed by an Air Force General Officer, has been established at Wright-Patterson AFB, OH. Actual technology development will be conducted by contractors, universities, and in-house government laboratories. The SDIO will maintain high level review of the program. Contractors for engine module development are Pratt and Whitney, West Palm Beach, FL; General Electric, Evendale, OH; and Rockedyne, Canoga Park, CA. Contractors for airframe component development are General Dynamics, Fort Worth, TX; Boeing, Seattle, WA; Lockheed, Palmdale, CA; Rockwell, Los Angeles, CA; and McDonnell Douglas, St Louis, MO. There are 29 additional contractors with contracts totalling $86 million.

7. (U) PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project 3384, NASP Technology Program

A. (U) Project Description: This project contains technology development efforts in advanced propulsion concepts; advanced airframe design; high temperature, high strength, lightweight materials; computational fluid dynamics; and advanced thermal control technology. The project will create a broad technology base, generic in nature, which will support advanced engine and airframe development and result in significant risk reduction. Engine modules embodying advanced concepts such as ramjet with supersonic combustion (scramjet) will be built and tested. Airframe components will be designed, built, integrated, and tested with the engine modules. The project will develop the technologies to enable an assessment of the feasibility of constructing and flying a hypersonic research aircraft capable of horizontal takeoff and landing, sustained hypersonic cruise in the atmosphere, and direct insertion (single stage) into orbit.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Contracts were awarded to five airframe contractors and three engine contractors. Work began in the study of various airframe and engine design concepts. Complex computational fluid

dynamics equations for initial engine/airframe configurations were modeled and successfully run at simulated flight conditions on a supercomputer. Research began on development of lightweight, high strength, high temperature materials such as rapidly solidified titanium powder and carbon/carbon and metal-matrix composites. Preliminary analysis began on engine test facilities requirements. Mission application studies were initiated.

(2) (U) FY 1987 Program: Based on detailed reviews of contractor preliminary designs, there will be a down selection to no more than three airframe contractors and two propulsion contractors in FY 1987. Computational fluid dynamics calculations will be expanded to include more detailed designs modeled over a broader range of simulated flight conditions. Materials, including metal-matrix composites, ceramic composites and advanced titanium alloys, will be fabricated and tested at representative temperatures and loading conditions. Research will be conducted and designs developed for advanced cooling concepts, integral reaction control systems, advanced electrical energy generation, and advanced avionics systems. Design efforts leading to the fabrication of critical engine components and selected sub-scale airframe components will be conducted. Mission application studies will be continued and expanded. Preliminary vehicle fabrication studies and flight test planning will begin. Contracts to upgrade test facilities will be let.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Work will continue on complex computational fluid dynamics calculations, with the refinement of computer models based on actual airframe and engine component test data. Modeling, utilizing supercomputer capabilities will include external and internal aerodynamics, aerothermodynamics, kinetics, and thermo-structural loading. Work will continue in the development of advanced materials, and manufacturing technologies will be investigated. Construction of engine and airframe components will begin. Components of tank structure for cryogenic fuel will be built and tested for integrity. Engine test facilities will begin initial operation. Propulsion vehicle control systems, including sensors and actuators, will be designed and integrated. Vehicle fabrication planning and flight test planning will continue. Mission application studies and survivability analyses will continue. The engine and airframe contracts are firm fixed price with not-to-exceed options through FY 1989. Cost estimates are based on firm design with contractor backup (Cost Category II, Mature).

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Materials, computational fluid dynamics, control systems and other key technology work will continue while engine/vehicle airframe design integration is refined. Demonstration of full scale, near flight weight engine modules will occur. Airframe preliminary design will be completed. Assessment will be made of engine, airframe and key technologies as well as readiness to enter into fabrication of experimental vehicles. After a competitive demonstration program, one engine and one airframe contractor will be selected to design and build the X-30 flight research vehicle. Cost estimates are based on firm design with contractor backup (Cost Category II, Mature).

(5) (U) Program to Completion: Technology development will continue. Two X-30 flight research vehicles will be fabricated. A flight research program will be conducted to demonstrate the viability of single-stage-to-orbit and sustained hypersonic cruise operation. Studies will be made as to the feasibility of a decision to enter full scale development of follow-on operational vehicles.

C. (U) Major Milestones:

Milestones	Dates
(1) (U) Engine/Airframe Design Reviews (Phase II)	4th Quarter FY 1987
(2) (U) Engine Module Ground Test Complete (Phase II)	4th Quarter FY 1989
(3) (U) Technology/Survivability/Vulnerability Assessment Complete (Phase II)	4th Quarter FY 1989
(4) (U) Research Vehicle Preliminary Design Review (Phase III)	3rd Quarter FY 1990
(5) (U) First Flight (Phase III)	2nd Quarter FY 1993

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63302F   Title: Space and Missile Rocket Propulsion
DOD Mission Area: 553 - Engineering Technology (ATD)   Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	3,071	5,706	8,973	12,208	Continuing	N/A
6339	Air-Launched Missile Propulsion Technology	1,275	2,087	2,714	2,340	Continuing	N/A
6340	Space Systems Propulsion Technology	1,586	3,319	5,259	8,368	Continuing	N/A
6341	Ballistic Missile Propulsion Technology	210	300	1,000	1,500	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Advanced rocket propulsion technology provides tactical and strategic weapons and space systems with increased mission capabilities and improved reliability and maintainability at reduced cost and risk for future weapon systems development. This program demonstrates timely, cost-effective enabling rocket propulsion technology for transition to systems application. The technology specifically satisfies needs in key mission areas: space systems, ballistic missiles, and air-launched missiles. This Science and Technology program is the only one within the Air Force to integrate and demonstrate leading rocket propulsion technologies prior to transition into full-scale development for future space and missile systems. The efforts in this program do not duplicate tasks conducted under the Strategic Defense Initiative.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	3,295	12,911	16,477	N/A	Continuing	N/A

EXPLANATION: Difference due to FY 1987 Congressional reduction. The FY 88 reduction accommodates reduced Air Force Total Obligation Authority.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable

5. (U) RELATED ACTIVITIES: This program demonstrates technology developed initially in the exploratory development program 62302F, Rocket Propulsion. These two programs are the total Air Force investment in rocket propulsion science and technology. Coordination with other Department of Defense organizations is accomplished through the Joint Army-Navy-NASA-Air Force Interagency Propulsion Committee. This committee is made up of subcommittees that include technical representatives from all agencies.

6. (U) WORK PERFORMED BY: This program is managed by the Air Force Rocket Propulsion Laboratory, Edwards AFB, CA. All work is done under contract. The current contractors are Morton Thiokol, Wasatch Operations, Brigham City, UT (6339); Hercules Inc, ABL, Cumberland, MD (6339); Rockwell International, Rocketdyne Division, Canoga Park, CA (6340); and Aerojet Strategic Propulsion Co, Sacramento, CA (6341).

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 6339, Air-Launched Missile Propulsion Technology. The objective of this project is to demonstrate advanced rocket propulsion technology for air-launched missiles. The demonstrations are performed in a representative size to be applicable to several systems. This demonstration is necessary to reduce the risk to acceptable levels for full-scale development of missile propulsion. In FY 1986 one preliminary design motor was ground tested from the Advanced Air-Launched Motor (AALM) program and two more motors were fired in the final flightweight configuration. The AALM is two-thirds the size of the current Short Range Attack Missile (SRAM A) motor, but provided a 50 percent increase in stand-off range when this technology was applied to SRAM II. This improvement is possible due to a combination of energy management techniques, high energy propellants, and lightweight composite motor cases. A High Performance/Low Observables Motor Demonstration Program began in FY 1986, emphasizing high performance with lower visible and radar signatures from the motor and plume. This new program will demonstrate motors in full-scale ground tests and will provide flight-qualified motors for the Advanced Missile Technology Integration flight tests in 1990. Promising technologies include low signature/high energy propellant for increased range, maneuvering during terminal engagement for higher kill probability, and composite cases and nozzles for decreased missile weight. The technologies will increase launch aircraft survivability and missile effectiveness with missiles that are more difficult to detect and evade, while providing the launch aircraft with increased stand-off capability. In the initial phase of this effort, two contractors will prepare motor designs. One contractor will be selected to continue on the merit of his design. Design and analysis will be completed in FY 1987 and component development will begin. In FY 1988, component development will be completed and fabrication will begin of heavyweight, assembled motors for static ground tests. The design will be refined from heavyweight motor firing data, and fabrication of flightweight motors will begin. In FY 1989, fabrication of flightweight motors will be completed and ground-test firings will begin to qualify the motors for flight testing.

B. (U) Project: 6340, Space Systems Propulsion Technology. The objective of this project is to demonstrate advanced propulsion technology for satellites and other space systems, principally for orbit maintenance, evasive maneuvering, and propulsion from low-earth orbit to higher orbits (e.g., geosynchronous). The Air Force's growing use of space requires low-cost propulsion and assured access. The demonstration of new propulsion systems will fill these requirements and a critical gap in satellite orbit transfer capability left by the cancellation of the Shuttle-launched Centaur. Current systems have limited payload capability and lack flexibility. In FY 1986 two developments were initiated to provide high-performance satellite propulsion. First, the Flightweight XLR-132 engine is a modular, storable propellant, space-propulsion system that can be used in a single engine configuration for evasive maneuvering for survivability against the anti-satellite threat, or in multiples to provide a 140 percent increase in payload capability (compared to the Inertial Upper Stage). The modular design allows the ability to cluster any number of engines in a separate stage or to incorporate an engine within a satellite design. Use of storable propellants enables

a capability for long term operation in orbit. Use of the modular concept avoids large developement cost of propulsion peculiar to a given satellite by using a proven, available engine to meet propulsion requirements. The potential application of the modular, storable, space propulsion work was cited in Technology Transition Plans for the Global Positioning System Block IIB and III changes desired in FY 1988 to 1989; Defense Satellite Communication System III follow-on desired between FY 1990 and 1992; Defense Support Program follow-on desired from FY 1988 to 1990; and Upper Stage Propulsion Systems desired in FY 1992. The second demonstration initiated in FY 1986 is a compact, cryogenic-propellant feed system utilizing a space-saving, toroidal, liquid oxygen tank. Using the toroidal tank on an upper stage operating out of the space shuttle cargo bay provides a 38 percent increase in payload capability over the Shuttle deployed Centaur. In FY 1987 the Flightweight XLR-132 (modular, storable, space-propulsion) effort continues with completion of the engine design. Also in FY 1987 development will begin on a low-thrust cryogenic-propellant engine to accompany the compact cryogenic-propellant feed system. A combination of the low thrust engine and the compact cryogenicpropellant feed system will provide a lift capability for over 17,000 pounds of payload to geosynchronous orbit compared to 10,600 pounds for the modified Centaur. Further work on the compact cryogenic-propellant feed system design effort will be delayed in deference to higher priority work on the low-thrust engine. In FY 1988, this project will continue work on the Flightweight XLR-132 Engine and low-thrust cryogenic-propellant engine. Flightweight XLR-132 Engine will complete component evaluation prior to final design and hot-engine firing of assembled components. In FY 1989, the low-thrust cryogenic-propellant engine will complete component evaluation necessary before final design for the assembled engine. The Flight-weight XLR-132 will begin demonstration groundfirings of a complete engine. In addition, in FY 1989 four new efforts will begin. Design activities will resume on the compact cryogenic-propellant feed system. A new advanced space propulsion effort will begin to demonstrate an electric propulsion thruster. This arcjet thruster can provide performance increases of 65 to 120 percent over chemical propulsion. A new space radiator for satellites will be developed to increase heat rejection capabilities for large, high-power-consumption satellites. Initial feasibility demonstrations indicate that a liquid droplet radiator would weigh only 25 percent of current radiators, enabling substantial satellite weight reduction. The fourth FY 1989 start, the air-launched space defense motor, could provide a 150 percent increase in altitude capability for the current anti-satellite system when used as a replacement for the first stage. A Technology Transition Plan recognizes the need for this increased capability.

C. (U) Project: 6341, Ballistic Missile Propulsion Technology. The objective of this project is to demonstrate advanced technology concepts for ballistic missile systems. It provides propulsion advances for increases in strategic force capability. An effort to develop Advanced Integrated Stage Concept for ballistic missiles began in FY 1986. The Integrated Stage Concept is a revolutionary motor configuration nesting the forward dome of the first stage motor case into the nozzle of the second stage motor to increase the volume available for propellant or decrease the inert weight. The integrated stage configuration replaces the weight and volume-inefficient length of the interstage dedicated to packaging a conventional motor's exit cone. This concept could increase missile range from 10 to 27 percent or provide a smaller, lighter missile with the same range. Propellant demonstration in support of this concept will be conducted during FY 1987. The Integrated Stage Concept motor design will be completed in FY 1988. Component evaluation and testing will begin in FY 1989 for the hot-gas thrust vector control, forced-deflection nozzle, new composite lower-stage-nozzle/upper-stage-dome structure, and a boron propellant for low nozzle erosion and improved exhaust gas properties.

Program Element: #63302F Title: Space and Missile Rocket Propulsion
DOD Mission Area: #553 - Engineering Technology (ATD) Budget Activity: #2 - Advanced Technology Development

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63363F — Title: Hypervelocity Missile (HVM)
DOD Mission Area: 553 - Engineering Technology — Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	6,298	9,382	11,626	7,783	Continuing	N/A
2718	Hypervelocity Missile Technology Demonstration	6,298	9,382	10,626	5,583	0	49,235
3254	Advanced Missile Technology Integration	0	0	1,000	2,200	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Hypervelocity Missile (HVM) system concept incorporates a small, fast, low-cost, command-guided missile to achieve multiple vehicle kills on a single pass. The high aircraft loadout, resulting from the small missile size and low cost, affords a significant increase in kills per sortie. The Air Force Armament Division has devised a technology demonstration program that will culminate with the air-launched flight test of multiple missiles being fired and simultaneously guided to two different targets. Targeting and missile tracking information will be provided by a forward-looking infrared tracking system. This program will demonstrate the feasibility of the HVM concept, and will provide a basis for the decision to proceed with full-scale development. The HVM system concept promises to give the United States an impressive increase in firepower for the anti-vehicular mission, at an equally impressive decrease in cost per target destroyed. The Army and Marine Corps also strongly support the system for use on both light assault vehicles and possibly on helicopters. A Memorandum of Agreement among the three Services' Assistant Secretaries was signed on 10 October 1984 establishing a joint effort to share the costs of developing common components and to conduct a joint ground-launched demonstration to validate the system concept. The Air Force is the lead Service in this effort, the first tri-Service antiarmor weapon development program. The Advanced Missile Technology Integration project (3254) will begin in FY 1988. The objective of this effort will be to integrate emerging air-to-air missile component and subsystem technologies and demonstrate their performance and payoff potential through hardware-in-the-loop simulation and limited flight test. This project will serve as the basis for reducing risk and transitioning high payoff technologies from laboratory development to full scale development. Work in this project supports the Air Defense Initiative and other Air Force programs.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	10,456	9,609	11,972	N/A	0

EXPLANATION: (U) Congressional approval of FY 1985 reprogramming action was completed 30 September 1985, precluding obligation/expenditure in FY 1985. These funds ($3,780 thousand) were used first in FY 1986 while some of the

remaining FY 1986 funds were reprogrammed to other efforts with a required payback to HVM in FY 1988 and FY 1989 to complete the demonstration.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands) Not applicable.

5. (U) RELATED ACTIVITIES: The US Army and US Marine Corps are working closely with the Air Force Armament Division (AD) on this program, determining its potential for use on their light assault vehicles. The US Army and Marine Corps are also considering HVM for airborne applications. A Memorandum of Agreement (MOA) among the Air Force (AF), Army (USA) and Marine Corps (USMC) specifying that the three Services will share the costs of developing common components for their respective hypervelocity missile systems, was signed by the three Services' Assistant Secretaries on 10 October 1984. This MOA pertains to FYs 1984 through 1987, and will culminate in the successful ground launch and guidance of both the AF and USA/USMC missiles. The MOA also designates the Air Force as the lead Service. The USMC share of this program is ($10.0 million) being funded by PE 63611M, Mobile Protected Gun System, and the USA share ($11.7 million) is funded by PE 63313A, Missile/Rocket Components. The following AF programs will provide inputs to Advanced Missile Technology Integration (AMTI): Conventional Munitions (PE 62602F); Conventional Weapons (PE 63601F), Space and Missile Rocket Propulsion (PE 63302F), and Advanced Turbine Fuel Technology (PE 63215F). Interrelationships between the AMTI project and other AF efforts are governed by the Memorandum of Understanding (MOU) signed by the Air Force Aero Propulsion Laboratory, Air Force Rocket Propulsion Laboratory, and the Air Force Armament Laboratory. Actions are in progress to add the Air Force Flight Dynamics Laboratory, Naval Weapons Center and the Army Missile Command to the AMTI MOU. These actions will ensure proper coordination and interrelationship with the following related programs: Missile Technology (PE 62303A), Surface/Aerospace Weapons Technology (PE 62332N) and Flight Vehicle Technology (PE 63205F).

6. (U) WORK PERFORMED BY: The Air Force Armament Division, Eglin AFB, FL, is the responsible technical organization for this program. The US Army Missile Command, Huntsville, AL, will provide support for US Army requirements; the USMC Development and Education Center, Quantico MCAS, VA, for the Marine Corps requirements. Test facilities at the Armament Division, Eglin AFB, FL, and the White Sands Missile Range, NM, will be used to support the program. The primary contractor on this program is LTV, Vought Corporation, Dallas, TX. AMTI, Project 3254, when initiated in FY 1988, will be managed by the Air Force Armament Laboratory, Eglin AFB, FL, and contractors will be selected by competitive bid.

7. (U) PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY.1989:

(U) Project: 3254, Advanced Missile Technology Integration (AMTI). The purpose is to integrate emerging air-to-air missile component and subsystem technologies (guidance, control, fuze, warhead, propulsion, power) into future missile improvements. This project supports developmental efforts for the Air Defense Initiative. It will demonstrate the performance and payoff potential of guidance/control, fuze/warhead and propulsion/power subsystems

through extensive hardware-in-the-loop simulation and limited flight test. This project will provide the mechanism for reducing risk, controlling costs and transitioning high payoff technologies from laboratory development to full scale development. In FY 1988 AMTI will design and fabricate a missile test bed using an AIM-120 (Advanced Medium Range Air-to-Air Missile (AMRAAM) airframe, autopilot, and motor with a soft recoverymechanism. This project will initiate integration of advanced guidance laws developed under PE 62602F, Conventional Munitions, into the test bed. Using the AMRAAM simulation as a baseline, the Air Force will initiate development of the digital and hardware-in-the-loop simulations needed to support the first series of flight tests which will begin in FY 1990. These initial tests will verify the flightworthiness and recoverability of the test bed, demonstrate the advanced guidance laws, and validate the simulation models. Starting in FY 1989 AMTI will complete integration of improved guidance laws and a Very High Speed Integrated Circuit (VHSIC) technology processor into the missile test bed fabricated during FY 1988, complete development and begin operation of the simulation capabilities required to support flight demonstrations of the processor and guidance laws and complete initial designs for integrating a pulse motor with the missile test bed. During future years, advanced guidance warhead, fuze, autopilots, and propulsion subsystem technologies will be demonstrated and evaluated in the AIM-120 test bed. Also, a more advanced test bed incorporating low drag, low observable missile airframe will be developed to demonstrate the potential payoff for use with follow-on aircraft such as the Advanced Tactical Fighter and other future weapons delivery platforms.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2718, Hypervelocity Missile Technology Demonstration

A. (U) Program Description: The HVM is a 5000 ft/sec, 66 lb., low cost ($8.5 thousand per missile), multiple target engagement weapon system for use against all vehicles, including armor. The HVM lethal mechanism represents a completely different approach from those used in current weapons. Instead of a chemical energy warhead, it uses a kinetic energy penetrator (rod or tube). This achieves a substantial reduction in missile size, weight and cost, while dramatically increasing the missile's flight velocity and the aircraft's combat loadout. These characteristics provide a marked increase in firepower-per-sortie, while simultaneously decreasing the aircraft's total exposure time. The high payoff potential of the HVM is that it can significantly increase the weapons available and the armament carried per sortie. The low cost per missile, combined with simple employment procedures, will reduce aircrew training costs. Additionally, the lack of an explosive warhead should significantly reduce logistic costs.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Contract for TASK III, the actual ground-launched demonstration, was signed in December 1985. Detailed design efforts for missiles will be completed and fabrication of the ground-launched demonstration missiles will begin. A five-task weaponization study is being conducted to include a HVM mission requirements analysis, HVM subsystem/system requirements definition, HVM subsystem/system concepts definition, cost/benefit tradeoffs and specifications/cost estimates. The spare "proof-of-concept" missile was fired to establish an initial data base on HVM plume effects on FLIR reception and display.

Program Element: 63363F | Title: Hypervelocity Missile (HVM)
DOD Mission Area: 553 - Engineering Technology | Budget Activity: 2 - Advanced Technology Development

(2) (U) FY 1987 Program: Weaponization study will be completed. Missile fabrications will be completed. System integration for the ground-launched tests will be completed, and firings of the twelve missiles for the ground-launched phase will begin. Packaging of the fire control system, and targeting system/missile/aircraft integration and qualification analyses for the air-launched phase will be initiated.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Requests: Missile/aircraft, targeting system/aircraft, and launch pod/aircraft integration and qualification will be completed. Single and multiple missile air-launched flight tests will be conducted. Concurrent studies will be conducted to address questions of full-scale development, production cost/schedule/risk, operational utility of the HVM weapon system concept for the Air Force's anti-vehicular mission, and weaponization concepts for tactical aircraft. The results of these tests and associated studies will support an FY 1989 decision to proceed to Full Scale Development (FSD) of the HVM weapon system. The cost information has been derived from detailed design analyses and firm contractor cost proposals (Category III).

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Air-launched demonstration will be completed in FY 1989. Test data will be analyzed and reports will be written. Testing, studies and other full-scale development (FSD) preparatory activities will be completed to support an FY 1989 decision to proceed to FSD of the HVM weapon system. The missile unit production cost information has been derived from detailed design analyses and firm contractor cost proposals (Category III).

(5) (U) Program to Completion: Successful completion of the air-launched tests in FY 1989 will conclude the HVM System Demonstration. This project will then transition to full scale development in a new Program Element.

C. (U) Major Milestones:

Milestones		Dates
(1) Preliminary Fire Control System Design Complete		October 1984
(2) Lightweight Missile Design Complete		July 1986
(3) Ground Launch Demonstration Complete	*(June 1987)	December 1987
(4) Flight Launch Demonstration Complete		April 1989
(5) FSD Decision		June 1989

* Date presented in FY 1987 Descriptive Summary

(U) Explanation of Milestone Changes:

Date has been revised after assessing the impact of late approval of FY 1985 reprogramming on the Ground Launch Demonstration. The Air Launch Demonstration completion will not be affected.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63401F Title: Advanced Spacecraft Technology
DOD Mission Area: 410 - Space Launch and Orbital Support Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		8,429	8,756	8,433	10,103	Continuing	N/A
2181	Advanced Space Computer Technology	6,729	6,256	5,496	7,008	Continuing	N/A
2198	Advanced Space Technology Planning	100	0	0	0	0	1,270
682J	Advanced Space Power Supply Technology	1,600	2,500	2,937	3,095	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This technology program defines, develops, and demonstrates new/improved spacecraft subsystem concepts/prototypes which support numerous DOD programs. The developments are essential to assure DOD space mission needs are met in the late 1980s and early 1990s. The primary objective of this program is to increase satellite autonomy, performance, reliability and lifetime. A secondary objective is to accomplish the performance improvements with lighter, less complex, and more economical subsystems than currently exist. Efforts include technology planning, and development of computer subsystems, and power supplies.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY ($ in thousands)

RDT&E	6,821	14,373	19,815	N/A	Continuing	N/A

EXPLANATION: (U) Decreases in program funding are a result of higher prioritized Air Force programs.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable

5. (U) RELATED ACTIVITIES: Project 682J (Advanced Space Power Supply Technology) receives power system technology inputs from PE 62203F (Aerospace Propulsion). Project 2181 (Advanced Space Computer Technology) receives inputs from PE 63452F (Very High Speed Integrated Circuits). The Advanced Spacecraft Technology program flight tests its payloads via PE 63402F (Space Test Program).

6. (U) WORK PERFORMED BY: The Air Force Space Technology Center, Kirtland AFB, NM, manages the program and executes Projects 2181, and 2198. The Air Force Aeropropulsion Laboratory, Wright-Patterson AFB, OH, executes Project 682J. The primary contractors are Hughes Aircraft Co., El Segundo, CA (Project 628J--Solar Cells and Batteries); Sandia National Laboratory, Albuquerque, NM; International Business Machines, Manassas, Va; RCA, Moorestown, NJ; Honeywell Inc., Clearwater, FL; Singer Kearfott, Melbourne, FL (Project 2181--Space Hardened Electronics).

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 682J, Advanced Space Power Supply Technology: This project develops and demonstrates power system technology for subsystems and components for spacecraft. These technologies will provide increased power output, lifetime and increased nuclear and laser hardness at substantially reduced volume, cost and weight. Development efforts include: Gallium Arsenide (GaAs) solar cells, Nickel-Hydrogen (NiH_2) batteries, high energy density Sodium Sulfur (NaS) rechargeable battery, survivable solar concentrator photovoltaic array panels, and advanced multi-band gap GaAs solar cells. A performance data base is being established by ground testing the batteries in simulated orbits and flight testing solar cells as a space experiment such as on the Combined Release and Radiation Effects Satellite (CRRES) experimental test of GaAs solar panels. Planning for a program to develop a High Energy Density Rechargeable Battery (HEDRB), based on the Department of Energy's research on Sodium-Sulfur batteries, will continue in FY 1987 and FY 1988. The FY 1987 program will continue to design, develop, and demonstrate satellite system technologies to provide necessary increased power generation, storage, and conditioning capabilities. The NiH_2 IPV cell completed qualification testing in FY 1986. Life performance testing (lasting five years) of NiH_2 batteries will begin in FY 1987 and continue through FY 1992. The launch of the CRRES satellite, carrying the GaAs solar cell experiment has been delayed to at least FY 1990. The GaAs solar cell experiment has been delivered in FY 1986 to the CRRES satellite contractor. After the experiment is integrated and checked out, the satellite will be placed in storage. Funds in FY 1988/1989 will fund storage activites. The development of a survivable concentrating photovoltaic solar array will begin in FY 1987.

B. (U) Project: 2181, Advanced Space Computer Technology. This project funds space hardened microelectronics which will increase the survivability and onboard data processing capability of military space systems. Military satellites are key links in the U.S. warfighting capability and must be survivable. These satellites currently require advanced computer electronics, hardened to survive the space environment, will improve space satellite mission performance. Future missions have identified the need for a factor of 10 to 100 improvement in onboard processing capability. The microelectronics package to fly on CRRES was delivered to the CRRES contractor in FY 1986. In FY 1987, this package will be integrated, checked out and prepared for launch. Funds in FY 1988/1989 will support storage activities of the CRRES satellite until its planned launch in FY 1990. The first lot of 64K Random Access Memory (RAM) test chips completed testing in late FY 1986. The results of these tests identified severe design problems. Because these design problems would require additional funds to correct, the 64K RAM development will be integrated into the Generic Very High Speed Integrated Circuit computer development providing the required time and resources to solve design problems. The first lot of 256K Electronically Erasable Programmable Read Only Memory (EEPROM) test chips will be tested early in FY 1987. Following this initial testing, subsequent chip deliveries in FY 1987 and early FY 1988 will undergo qualification testing completing the development program in FY 1988. In FY 1986 the 4MBIT bubble memory chip technology development contract was awarded. However, during the year the 4MBIT development contractor decided not to pursue future bubble memory

development/production programs. Because of this decision, the 4MBIT bubble memory chip development will be significantly reduced in FY 1987 and the contract terminated. The funds for the 64K RAM and 4MBIT bubble memory development efforts will be used to offset cost growths in the Genric Very High Speed Integrated Circuit (GVSC) development program. In FY 1986 the Phase I GVSC development program will be completed with the delivery of test chips from four contractor Phase II GVSC will begin after government testing of these chips has been accomplished. Two contractors will develop chip sets of a space qualified GVSC computer beginning in FY 1987. The GVSC development will continue with test chips planned to be available in FY 1988 and the delivery of a GVSC computer breadboard scheduled to be available for testing in FY 1989. In parallel with the GVSC development program is the development of a fast access memory device. This effort is planned to begin in FY 1987 and devices are planned to be made available in FY 1989. This is a continuing advanced technology development program.

8. (U) PROJECTS OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63410F Title: Space Systems Environmental Interactions Technology
DOD Mission Area: 552 - Environmental and Life Sciences (ATD) Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		3,793	3,534	3,825	3,934	Continuing	N/A
2821	Space Systems Design and Test Standards	500	505	675	750	Continuing	N/A
2822	Interactions Measurement Payload	2,378	2,229	2,300	2,434	Continuing	N/A
2823	Charge Control System	915	800	850	750	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The space environment can seriously degrade operations and performance of large, high-powered space systems planned for operation in the 1990s. These new systems will not meet the most stringent requirements for survivability, reliability, autonomy and long-lived operation unless they are designed to mitigate these environmental effects. Environmentally induced problems identified by recent experiments from Shuttle and other satellites include: malfunctions of on-board microelectronics; spacecraft charging/discharging during polar orbit; possible limits on manned operations due to charging/discharging of extravehicular activity equipment; decreased materials stability associated with increased contaminants; deformation of radar antenna or large-system optics; power loss and materials damage to large solar arrays caused by interaction with space plasma; and significant materials degradation. This Science and Technology program develops a basis for countering adverse effects of the space environment on Air Force space systems by quantifying interaction effects and developing design guidelines, test standards, and Computer Aided Engineering tools for inclusion in Military Standards for advanced space systems. Engineering design tools and a spaceflight-qualified charge control system will be delivered to system developers. This program represents the Air Force advanced development portion of a National Aeronautics and Space Administration (NASA)/Air Force Systems Command Agreement for Space Interdependency on Spacecraft Environment Interactions.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	3,854	8,529	7,006	N/A	Continuing	N/A

EXPLANATION: (U) Congress reduced FY 1987 budget request by $5.0 million. FY 1988 program reduced to accommodate Air Force Total Obligation Authority reduction.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: National Aeronautics and Space Administration (NASA) and the Air Force coordinate laboratory development in technology which this program transitions into solutions to specific space systems problems. Program Element 62101F, Geophysics, at the Air Force Geophysics Laboratory, is a major contributor to advanced development in environmental interactions technology. The Navy and the National Oceanic and Atmospheric Administration also conduct programs centering on the space environment. These efforts are reviewed and coordinated formally with PE 63410F at the annual tri-service Science and Technology program review by the Office of the Under Secretary of Defense for Research and Engineering. The NASA/Air Force Space Technology Interdependency Working Group coordinates NASA/Air Force efforts continuously and reviews the programs at annual meetings.

6. (U) WORK PERFORMED BY: This combined in-house and contract program is being managed by the Air Force Geophysics Laboratory, Hanscom AFB, MA. The primary contractors are Jet Propulsion Laboratory, Pasadena, CA (2822); Hughes Research Laboratories, Malibu, CA (2823); and S-Cubed Incorporated, La Jolla, CA (2821).

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 2821, Space Systems Design and Test Standards. This project applies the results of NASA and DOD space environment interaction research and technology development to produce design guidelines and test standards to alleviate environmental sensitivities in space system designs. In FY 1986, current research results on space environment interactions and methods for improving spacecraft reliability and survivability were delivered to space system developers. Work began to adapt computer models for charge buildup on spacecraft into Computer-Aided Engineering (CAE) design tools for spacecraft developers. (Charge build-up on spacecraft, one of the most serious space environment hazards, can degrade system operation, cause damage to the spacecraft and reduce system performance.) Preparation began on a Spacecraft Environmental Anomalies Military Handbook for developers and operators to use as a guideline for reducing environmental sensitivities of spacecraft. In FY 1987, the spacecraft charging CAE tool will be completed. Precontract work will be completed for military handbooks (design and test guidelines) covering spacecraft sensitivity to charging at geosynchronous altitude and in low-earth-orbits. Validation of the Polar Orbit Large Object Charging (POLAR) computer code for use by spacecraft designers will continue. During FY 1988, the Spacecraft Environmental Anomalies Military Handbook will be completed. Contract work will begin to prepare military handbooks (design and test guidelines) covering spacecraft sensitivities to charging at geosynchronous altitude and in low-earth-orbits. Work will begin on a standardized handbook to specify the space environment for satellite designers. During FY 1989, the Geosynchronous Spacecraft Charging Military Handbook will be completed. Work will continue on the military handbook for low-earth-orbit spacecraft charging. The POLAR code validation and the space environment handbook will be completed. Work will begin on orbital contamination and erosion effects handbooks.

B. (U) Project: 2822, Interactions Measurement Payload (IMPS). This project designs, fabricates and flight tests a comprehensive experimental package on the Shuttle to quantify environmental interactions known to affect planned operational systems. IMPS output will provide direct input and validation for Project 2821 efforts to develop guidelines and standards for planned military space systems. IMPS results will help avoid operational failures of future space systems due to unanticipated environmental effects. This project also includes efforts to investigate possible limits on manned operations due to electric charge build-up and discharge on extravehicular activity equipment. In

FY 1986, most of the preliminary design for the Interactions Measurement Payload (IMPS) engineering and science instrument complement was completed. Flight configuration design for the Photovoltaic Array Space Power experiment, the Surface Potential Monitor, and the diagnostic instruments was initiated. Initial tests and analyses of astronaut extravehicular activity (EVA) suit material were completed, confirming material susceptibility to charging and arc-discharge in polar orbit. Planning was initiated for ground and flight evaluations of the effects of charging on EVA equipment. The FY 1987 program will complete the flight design for a majority of the IMPS engineering and science instruments and begin the fabrication and test of flight hardware. Planning for the astronaut EVA equipment ground and flight evaluation will continue. In FY 1988, fabrication of the IMPS experiments will be nearing completion. Experimental payload integration and test planning for the complex instrument complement will continue. Definition of mission operations, data collection and analysis procedures will commence. Planning for the EVA equipment ground evaluation will continue. During FY 1989, fabrication of IMPS experiments will be completed. Each instrument will be qualification tested prior to delivery to the experimental payload integrating contractor. The experimental payload will be integrated and fully tested prior to delivery to the Space Test Program for launch integration. Data evaluation techniques will be largely completed. Detailed flight mission planning for IMPS will commence. The IMPS launch is currently planned for FY 91. Ground simulation test planning and equipment will be completed to evaluate polar-orbit charging effects on EVA equipment. Preliminary planning for the design of the EVA flight experiment will be initiated.

C. (U) Project: 2823, Charge Control System. An automated Charge Control System (CCS) will be designed, developed and flight tested to produce a spaceflight-qualified system to actively control charge buildup on spacecraft. The buildup of large differential electrical charges on spacecraft and the subsequent catastrophic discharge (arcing) can degrade system operation, cause damage to the spacecraft and reduce system performance. In FY 1986, preliminary and detailed design of the prototype CCS was completed. Work began on prototype fabrication. In FY 1987, fabrication of the prototype components will continue and preparations for factory performance testing will begin. During FY 1988, flight prototype fabrication will be completed and qualification testing will commence. Definition of spaceflight operational procedures, data collection and data analysis methods will commence. In FY 1989, flight prototype qualification testing will be completed. Ground verification testing will commence to establish baseline flight performance characteristics for spaceflight experiment operation. Spaceflight operational procedures and data evaluation plans/methods will be largely completed. Support will be provided to start the integration of the CCS on a geosynchronous operational satellite. In FY 1990, ground verification testing will be completed and the CCS will be launched on a host geosynchronous spacecraft. Data collection and analysis of flight data will commence. When operational the CCS will increase reliability and survivability of military space systems in geosynchronous orbit by eliminating the hazards of spacecraft charging.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63452F
DOD Mission Area: 551-Electronic and Physical Sciences (ATD)
Title: Very High Speed Integrated Circuits (VHSIC)
Budget Activity: 2-Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		189,751	123,868	101,413	58,127	0	940,730
2700	VHSIC	189,751	123,868	101,413	58,127	0	940,730

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: For many years the basic US defense strategy has rested on the premise that the numerical superiority of our adversaries could be offset by technologically superior weapons. Key to this strategy has been the incredibly rapid advances in integrated circuit technology which has revolutionized the concept of weapon system design. The VHSIC program, a Tri-Service program, was initiated in order to accelerate the insertion of advanced integrated circuit technology into military sytems. The VHSIC plan is to develop two generations of integrated circuits with very high information processing capacity for a wide range of military systems. Initial applications include digital signal processors for radar, antisubmarine warfare, communications, missile guidance, electronic warfare, and optical sensor systems. Payoff in these systems will include enhanced performance and reliability and reduced life-cycle cost. Many systems will not obtain performance objectives without this component technology. The program structure stresses ready access to the technology by military system designers and rapid introduction of these components into the operational inventory. By Congressional direction, the program is centrally managed in the Office of the Under Secretary of Defense for Research and Engineering, and the Air Force budgets for and administers the total program funding for all the Services. This is a Science and Technology Program.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	201,994	132,897	29,548	N/A	74,725	906,735

EXPLANATION: (U) Difference in FY 1986 funds represents addition of $3.9 million by OSD for a special effort and reductions to meet Gramm-Rudman-Hollings ($11.4 million), inflation adjustments, and small business innovative research. Differance in FY 1987 funds represents Congressional reductions in the program and inflation adjustments. Funds were added to FY 1988 to ensure successful implementation of the first generation VHSIC chip development and to complete the second generation VHSIC technology in a timely manner to assure our lead in electronics over potential adversaries. Difference in total estimated cost is because of the addition of funds to reflect completion of the VHSIC program at the end of FY 1989.

4. (U) OTHER APPROPRIATION FUNDS: Not applicable.

PE: 63452F

5. (U) RELATED ACTIVITIES: This is a Tri-Service program with management and technical oversight executed by the Office of the Under Secretary of Defense for Research and Engineering. The Director, Computer and Electronics Technology, in the Office of the Under Secretary of Defense for Research and Engineering, coordinates the work within the program and work related to it. An Executive Committee, chaired by the Deputy Under Secretary of Defense for Research and Engineering, Research and Advanced Technology, with participation by the Services and other concerned agencies, exercises oversight and sets program policy for the VHSIC program. Related activities include: Aircraft Avionics (PE 62202A); Electronic and Electron Devices (PE 62705A); Electron Device Technology (PE 62762N); Aerospace Avionics (PE 62204F); Aircraft Avionics Equipment (PE 63207A); Avionics (PE 63202N); Advanced Device Development (PE 63742N); Advanced Avionics for Aerospace Vehicles (PE 63203F); and Integrated Electronic Warfare System/Integrated Communications Navigation Identification Avionics Advanced Development (PE 63109F). In addition, a major manufacturing program is in progress (PE 78011F) to ensure VHSIC components are mature, available and affordable.

6. (U) WORK PERFORMED BY: The Office of the Under Secretary of Defense for Research and Engineering executes program management of VHSIC. The work is monitored in the following organizations: Army Electronic Technology and Device Laboratories, Electronic Warfare Laboratory, and Communications Research and Development Command, all at Fort Monmouth, NJ; Army Missile Command, Huntsville, AL; Army Armament Research and Development Command, Dover, NJ; Army Night Vision and Electro-Optics Laboratory, Fort Belvoir, VA; Army Research Office, Research Triangle Park, NC; Space and Naval Warfare Command, Naval Research Laboratories, both in Washington, DC; Office of Naval Research, Arlington, VA; Naval Air Development Center, Warminster, PA; Naval Surface Weapons Center, Dahlgren, VA and White Oak, MD; Naval Weapons Center, China Lake, CA; Naval Ocean Systems Center, San Diego, CA; Air Force Wright Aeronautical Laboratories, Wright-Patterson Air Force Base, OH; and Rome Air Development Center, Griffiss Air Force Base, NY. The major VHSIC contractors are TRW, Redondo Beach, CA; Westinghouse, Baltimore, MD; Hughes Aircraft Corp., Carlsbad, CA; Texas Instruments, Dallas, TX; Honeywell Inc., Minneapolis, MN; IBM Corp, Manassas, VA; and Intermetrics, Baltimore, MD. There are 28 additional contractors holding contracts totalling $87 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2700, VHSIC

A. (U) Project Description: The VHSIC program objective is to deliver prototype integrated circuits, brassboard demonstration subsystems, pilot production lines, computer-aided design tools, and device technology. Numerous systems in all three Services have been identified as prime candidates for VHSIC chips. Projected system payoffs include 5- to 10-fold reductions in size, weight, and power consumption; 10- to 100-fold increases in reliability and processing throughput; and significantly reduced costs of maintenance, supply, and modification. The program is divided into two major phases providing integrated circuits. In phase 1, first generation, militarized, very large-scale integrated circuits have been developed using 1.25 micrometer geometries - one-fortieth the size of a human hair - with an average of 20,000 logic gates per chip operating at 25 Megahertz. In Phase 2, second generation technology is being developed using submicrometer (0.5 micrometer) geometries - one hundredth the size of a human hair - with

75,000 to 5,000,000 gates per chip operating at 100 Megahertz. Additional efforts in the program include military qualification, and yield enhancement of the Phase 1 chips, development of design automation tools to accelerate the design of advanced military systems using VHSIC level technology and development of key lithographic tools for chip manufacture such as deep ultraviolet, electron beam and x-ray. The program also provides for rapid and early demonstrations of the Phase 1 technology through the technology insertion program.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: The Phase 1 yield enhancement thrust was completed in late FY 1986. The main goal of this effort to improve the yield of VHSIC chips (10%) in order to make them available and affordable for use in weapon systems was achieved. The VHSIC hardware descriptive language (VHDL) analyzer and design library manager were delivered. Testing of the VHDL by various government and industrial organizations has started. VHDL is a comprehensive common design language which will allow for the smooth transfer of VHSIC technology within the defense community. Design reviews on the Tester Independent Support Software System (TISSS) were completed. The objectives of the TISSS are to automate the generation and maintenance of electrical test specification and test programs for VHSIC devices and to provide a candidate standard machine readable representation to which test tools can be built. The Phase 2 contractors have demonstrated working 0.5 micrometer circuits on test chips and have completed design of a proof of concept 0.5 micron chip and interoperability standards. The first use of VHSIC technology in two operational weapon systems (ALQ-131 electronic countermeasures pod and the UYS-1 Acoustic Signal Processor) was successfully demonstrated. Use of VHSIC technology in these systems has the potential to greatly improve the mean-time-to-repair, mean-time-before failure and throughput processing speed. Over thirty efforts are ongoing in support of the early demonstration of VHSIC technology in weapon systems. VHSIC chips are available for prototyping and testing. Over 42,000 VHSIC chips have been produced in 23 different chip types with the majority being memory chips. The VHSIC chip tester installed at Rome Air Development Center was brought up to operational capability and is available for testing VHSIC chips produced by commercial sources.

(2) (U) FY 1987 Program: The FY 1987 program contains a balance of activities both to advance militarized very large-scale integration to the submicrometer regime needed for advanced high-throughput processors, and to quickly realize the potential of Phase 1 VHSIC technology in multiple operational systems. Phase 2 (submicron) contractors will complete process development and fabrication of a Bus Interface chip and/or a proof of concept demonstration. The completion of this milestone will demonstrate that the contractors have established a process for fabricating a complex chip with 0.5 micron features. On completion of this milestone, the Phase 2 contractors will continue to design the brassboard modules and start design on additional Phase 2 chips. The qualification program will continue. This program is a two step program. In the first step a representative chip from each contractor will be subjected to established military standard qualification requirements. This will test the basic integrity of each supplier's process and design system. Five representative chips will complete this qualification process in FY 1987. The second part of the qualification program is aimed at assuring potential users that all members of a chip set are (and will continue to be) equally suited for insertion into military systems. This step will require revision to the military standards, where necessary. Emphasis will continue on projects to promote the rapid insertion of Phase 1 technology into a wide range of weapon systems in all three services. Demonstrations of this early insertion thrust include signal processors for

radar, electronic warfare and communications applications. Development will continue on the Tester Independent Support Software System (TISSS) effort with coding of the software. The VHSIC hardware description language (VHDL) program will be completed and an Institute for Electrical and Electronic Engineer Industry standard based on VHDL will be completed. Work will be initiated to establish a pilot production line using the latest state-of-the-art X-ray lithography. This effort is needed to help establish manufacturing experience in using X-ray lithography to develop 0.5 micron circuits.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Submicron technology will continue with Phase 2 contractors designing and developing additional VHSIC chips with 0.5 micron features. These chips will be integrated into brassboard modules for evaluation. Phase 2 technology will offer a significant advance in system performance, reliability, size, weight and power requirements needed by military system designers. Final demonstration and testing of the TISSS will be completed and will be made available for use by government and commercial industry. TISSS will automate the generation and maintenance of electrical test specifications and test programs for VHSIC devices and provide a candidate standard machine readable representation to which test tools can be built. Step 1 of the qualification program will be completed by the addition of four VHSIC chips to the military qualified parts list. In step 1, representative VHSIC chips will be qualified under existing military standards as a means of testing the basic integrity of the supplier's process. In step 2 of the qualification program, initial verification of the generic qualification procedures for VHSIC chips will be completed. On completion of the demonstration, these procedures will be provided to government and industry organizations for final testing and verification. Efforts will continue on the development of a pilot production line using X-ray lithography equipment. Current production optical lithography equipment is not capable of correct alignment for 0.5 micrometer feature size chips. Definition of the VHSIC Engineering Information System (VEIS) will be completed and implemented. The VEIS is an object management system designed to manage engineering data. Work on the development of system level design automation tools will be completed. By using these tools designers can determine through simulation early in development, if the projected architecture will perform the desired functions adequately. Simulation and synthesis software tools allow the system designer to rapidly assimilate new chip technology into weapon system capability. Funding estimates are based on detailed program planning and analysis performed by Service experts in design automation, manufacturing reliability and testing, and other disciplines, and on experience gained in similar activities in the program, including firm contract pricing for efforts now in progress.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Development of VHSIC submicrometer technology will be completed with delivery of chips and brassboard modules for test and evaluation by the government. Phase 2 contractors will have put as many as 20 million transistors with 0.5 micron dimensions on a single chip. These densities will be needed to meet the high throughput signal/data processing requirements of future radar, communications, electronic warfare and smart weapons applications. Work on developing and demonstrating a pilot line using X-ray lithography will be completed. The success of using X-ray lithography will ensure that submicron feature size VHSIC chips will be readily available to meet the future needs for military systems. The Engineering Information System prototype will be delivered. Radiation enhancement work for Phase 2 submicrometer circuits and in-house test and evaluation of VHSIC chips will be completed. Early demonstration programs emphasizing the rapid insertion of VHSIC technology will be completed. Demonstrations of this early insertion thrust include signal processors for radar,

electronic warfare and communications applications. Testing and verification of generic qualification procedures (step 2 in the qualification program) will be completed. These new procedures will make the qualification requirements more efficient and responsive to the government's need for complex military application of specific parts. Funding estimates are based on detailed program planning and analysis performed by Service experts in design automation, manfacturing reliability and testing, and other disciplines, and on experience gained in similar activities in the program, including firm contract pricing for efforts now in progress.

(5) (U) Program to Completion: Not applicable.

C. (U) Major Milestones: Not applicable.

9. (U) COOPERATIVE AGREEMENTS: Not applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63601F
DOD Mission Area: 553 - Engineering Technology (ATD)
Title: Conventional Weapons
Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		25,220	24,291	25,021	31,519	Continuing	N/A
670A	Ordnance Technology	9,653	13,100	11,552	19,129	Continuing	N/A
670B	Guidance Technology	15,567	11,191	13,469	12,390	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Funds the advanced development and technology demonstration of advanced nonnuclear aircraft armament and weapons guidance technologies. New weapon concepts and technology applications are developed and tested to demonstrate feasibility, effectiveness, and operational potential. This program serves as the basis for follow-on system development and advanced prototyping programs and is vital to force survivability and the conventional deterrent posture of the United States.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	24,856	30,903	27,672	N/A	Continuing	N/A

EXPLANATION: (U) The FY 1987 reduction reflects Congressional action. The FY 1988 increase provides funding for a free-flight prototype demonstration of the Infrared High Value Target Acquisition (IRHVTA) seeker.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: This program demonstrates nonnuclear technologies initially investigated in Air Force exploratory development Conventional Munitions (PE 62602F), Aerospace Avionics (PE 62204F) and Rocket Propulsion (PE 62302F) programs. Coordination is maintained with Advanced Avionics for Aircraft (PE 63202F), Digital Avionics Information System (PE 63243F), Millimeter Wave Seekers (PE 63609F), and NAVSTAR/Global Positioning System (PE 64778F) Joint programs. Outputs from this technology base program are transferred to: Advanced Medium Range Air-to-Air Missile (PE 64314F), Millimeter Wave Seekers (PE 63609F), Armament Ordnance Development (PE 64602F), Submunitions (PE 64604F), Joint Technical Coordinating Group (JTCG) for Munitions Development, the JTCG for Munitions Effectiveness, and the and Surface Defense Suppression (PE 64733F) programs. Tri-Service coordination is accomplished through the Joint Service Guidance and Control Committee. Other joint specialized committees have been formed for specific technology sub areas. Jointly funded/sponsored tasks in this program include the Very High Speed Integrated Circuit technology in the Infrared High Value Target Acquisition program. International cooperation and coordination is under the auspices

of the Technical Cooperation Program and various specific country-to-country data exchange agreements, such as the NATO programs for infrared and millimeter wave target/background signature measurements.

6. (U) WORK PERFORMED BY: The Air Force Armament Laboratory, Eglin Air Force Base, FL, is the responsible technical activity for this program. Test facilities at the Armament Division, Eglin Air Force Base, FL; the Arnold Engineering Development Center, Arnold Air Force Station, TN; and the Naval Weapons Center, China Lake, CA, support this program. Major contractors on this program are: Raytheon, Bedford, MA (670B); Texas Instruments, Dallas, TX (670B); Goodyear Aerospace Corporation, Phoenix, AZ (670B); and General Electric Co., Burlington, VT (670A). Twenty-two other contractors and non-Air Force Government activities hold additional contracts valued at $44.6 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 670A, Ordnance Technology

A. (U) Project Description: Technology base effort to develop and demonstrate the feasibility, effectiveness and operational value of conventional nonnuclear ordnance technologies for air-delivered weapons. Project includes ordnance technologies for: fuzes, warheads, explosives, bombs, submunitions and their dispensing mechanisms, guns and ammunition, aircraft carriage and release techniques, and weapon ordnance subsystems integration. Objectives include: effective airfield denial, increase munitions and transportation safety and allow increased on-base ordnance storage through qualification of insensitive high explosives and demonstration of mechanical deterrents to bomb-to-bomb sympathetic detonation in transport/storage munition configurations, increase operational effectiveness against buried and hardened targets, increase aircraft gun effectiveness, hard target defeat, multiple kills per pass, more effective submunition dispensing, low cost manufacturing techniques, low drag weapon carriage, and increased operational flexibility.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Continued design and evaluation of high velocity aircraft gun and ammunition concept and initiated development of prototype models which will be used for feasibility demonstrations. Continued development of insensitive munitions technologies. Candidate mechanical solutions to the sympathetic detonation problem were transitioned to full scale development. Qualification of an Insensitive High Explosive formulation and configuration for general purpose bombs began. Initiated development of advanced fuze and warhead concepts for hard target weapons. Initiated an effort to integrate and demonstrate advanced low cost weapon techniques, manufacturing advanced dispensing concepts, high speed submunitions technology, and conformal carriage and release technologies which have been developed in previous 6.2 efforts.

(2) (U) FY 1987 Program: Initiate ground prototype demonstration of the advanced aircraft gun and ammunition designed in previous years. A prototype gun and ammunition capable of demonstrating the high muzzle velocities needed for an increased aspect gunnery capability will be fabricated. Continue development of hard target weapon technologies Evaluate and analyze advanced fuzing and penetrating warhead designs. Fuze designs will be evaluated to establish their performance and payoff potential to defeat complex underground targets. Similarly, candidate designs for a penetrator warhead capable of effectively defeating complex underground targets will evaluated. Continue development of insensitive munitions technologies. Emphasis will be toward final qualification and transition of a Desensitized High Explosive (DHE) and/or Insensitive High Explosive (IHE) formulation for use in general purpose bombs. Incorporation of either a DHE or an IHE in bombs will enhance munitions handling safety and relieve severe on-base storage problems faced in both European and Pacific theaters and will provide increased tactical operational flexibility. Continue efforts to integrate and demonstrate advanced dispenser weapon airframes, high speed submunitions, and conformal carriage and release technologies. Efforts will concentrate on applying low cost manufacturing techniques in the brassboard fabrication of weapon airframe hardware. Free flight demonstrations will be conducted in high speed sled track tests. Initiate integration and demonstration of advanced air-to-air missile subsystems technologies; initiate designs of missile test bed and hardware-in-the-loop simulations.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Complete ground demonstration of a flight weight aircraft gun and its associated telescoped ammunition. This gun is to provide muzzle velocities 50% greater than our current M-61 gun system, leading to greater lethality, longer effective range, and an increased aspect capability in air-to-air engagements. It will also provide enhanced capability for gunship operations through increases in standoff range. Complete the transition of a DHE or IHE formulation into general purpose bombs. Initiate development and initial screening of IHE candidate formulations for use in missiles and submunitions. The incorporation of DHE and/or IHE in our ordnance will reduce munitions storage quantity-distance (Q-D) criteria limitations in overseas theaters, increase munitions handling and storage safety and flexibility, and enhance operational capability. Continue development of hard target ordnance technologies. Fabricate and test the brassboard fuze and warhead components and evaluate options for an integrated ordnance package. This effort will provide a demonstrated capability to defeat underground hardened targets currently vulnerable only to nuclear attack. Complete ground test and evaluation of an advanced dispenser weapons airframe configuration and prepare for sled tests scheduled for FY 1989. This advanced weapons airframe effort will provide a demonstrated technique for the low cost manufacture of a low drag dispenser airframe capable of being carried on future aircraft without measurably degrading aircraft performance.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Continue development and qualification of IHE formulations for use with missiles and submunitions. Candidate formulations will be evaluated in full-scale warhead tests. Candidate formulations meeting both the insensitivity and performance criteria will be identified for boostering and qualification testing during FY 1990. Continue development and demonstrations of hard target ordnance technology. Brassboard components demonstrated during FY 1988 will be integrated into an ordnance package and subjected to field and sled tests to evaluate component interactions/interfaces and to assess overall performance. Design modifications and final performance testing will be completed in FY 1990 prior to transitioning to full-scale development for use in a hard target weapon. Complete development and demonstration of advanced dispenser weapon airframe designs and transition them to full-scale development. Conduct sled tests of full-scale composite airframes to validate structural integrity

and aerodynamic characteristics. This advanced dispenser airframe will incorporate advanced manufacturing techniques, composite materials advances, and low drag shaping to achieve a substantive increase in the performance at lower cost than current dispenser airframes. Combined with advanced carriage techniques, it will reduce the drag penalty of the delivery aircraft. Initiate development of improved high velocity combat ammunition for use with the advanced guns demonstrated in FY 1988. Projectile fuze and warhead designs initially demonstrated in PE62602F, Conventional Munitions, will be used as the baseline for designing a high lethality, high velocity combat ammunition that will have greater effectiveness over current aircraft gun ammunition. Initiate development of an improved counterair ordnance package which incorporates fuze and warhead technologies developed in PE62602F, and available warhead technology developed by the Navy and National Laboratories. This effort will provide an ordnance package as a product improvement to the Advanced Medium Range Air-to-Air Missile (AMRAAM) and the Advanced Short Range Air-to-Air Missile (ASRAAM). It gives 200-300% greater energy on target and expands the missile lethal area. Continue to improve the performances and cost effectiveness of cluster weapons. Previous efforts in PE62602F have demonstrated the feasibility of advanced warhead concepts, improved sensor designs and innovative maneuvering techniques. During FY 1988, designs for the integration of these advances will be developed and evaluated to assess their potential effectiveness. The advanced submunitions that result will improve the cost effectiveness of cluster weapons by providing more kills per weapon through increased probabilities of target acquisition, increased lethality for each submunition, and greater pattern control/area coverage per weapon.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not Applicable.

9. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 670B, Guidance Technology

A. (U) Project Description: Technology base effort to develop and demonstrate the feasibility, effectiveness, and potential operational value of advanced midcourse and terminal guidance technologies for air-to-air and air-to-surface weapons. Objectives include: standoff delivery/threat avoidance through preprogrammed autonomous seeker operation and longer range target acquisition, precision terminal guidance with increased accuracy, all-weather operation, increased tactical flexibility, automatic target classification and identification, reliable operation, and affordability.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Continued development and flight test of the Infrared High Value Target Acquisition (IRHVTA) seeker and its Very High Speed Integrated Circuit (VHSIC) processor for incorporation into an autonomous guided weapon. Initiated captive flight test of the Alternate Imaging Infrared (ALTIR) seeker concept. Continued Hardware-in-the-Loop (HIL) test and evaluation of the Advanced Seeker Technology Air-to-Air Missiles (ASTAAM) brassboard seeker and its associated VHSIC processor. Continued design and brassboard fabrication of Autonomous Synthetic Aperature Radar Guidance (ASARG) hardware. Continued test and evaluation of Self Protection Weapon (SPW) guidance concepts to develop a final guidance subsystem design.

(2) (U) FY 1987 Program: Complete HIL evaluation and captive flight test of the IRHVTA seeker and incorporate the technology into a prototype free-flight demonstration effort for an autonomous guided weapon. This seeker will reduce delivery aircraft attrition through an increased threat avoidance capability. The Infrared High Value Target Acquisition (IRHVTA) seeker will provide an affordable autonomous lock-on-after-launch guidance capability that eliminates the dependence on laser designators or data link pods for air-to-surface weapons while still providing precision accuracy. Complete captive flight test of the ASTAAM seeker and continue HIL test and analysis of integration of a VHSIC processor within the ASTAAM seeker. Continue the ASARG development effort. Efforts will concentrate on laboratory test and evaluation of a brassboard guidance subsystem. Initiate design and development of a low cost tactical laser radar seeker. Complete concept definition studies of a multi-spectral seeker for use in air defense against cruise missiles and reduced radar cross section aircraft. Results of this effort are to be used as the basis for the missile seeker concept development project.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Complete captive flight test of an alternate imaging infrared seeker. This seeker will provide competition for the IRHVTA seeker and is to be a lower cost alternative. Complete HIL test and evaluation of a VHSIC technology processor for air-to-air missiles and transition it to full scale development for integration with the ASTAAM seeker as a preplanned product improvement for the AMRAAM. The ASTAAM seeker, with this VHSIC processor, will provide the AMRAAM longer effective range and increased electronic counter-countermeasure capability. Complete the lab test and begin captive flight test of the ASARG seeker concept. The ASARG technology will provide an improved adverse weather capability for autonomous target acquisition, classification, and track. Continue development of a low cost tactical laser radar seeker system. Efforts will focus on the design and fabrication of the brassboard guidance subsystem and development of the HIL simulations to be used to evaluate performance. The laser radar technology complements previous imaging infrared seeker developments by providing more accurate range information to perform target classification and identification. This laser radar development will be specifically designed for low cost, tactical standoff range, and simple pre-mission planning. Conduct a free-flight demonstration of autonomous imaging infrared seeker technology to demonstrate its feasibility and potential payoff for use in guided bombs. This technology provides the capability to defeat fixed high value targets while allowing reduced aircraft exposure and subsequent attrition.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Complete free-flight demonstrations of autonomous imaging infrared seeker technology and transition it to full scale development in an autonomous guided weapon. This technology will provide a standoff, launch and leave weapon capable against fixed high value targets. Standoff employment enables the delivery aircraft to reduce or eliminate its exposure to terminal defenses to increase its survivability. Complete captive flight tests of the ASARG concept seeker. The ASARG technology provides an adverse weather, autonomous target acquisition and attack capability against both fixed and mobile ground targets. This technology will transition to full scale development in FY 1990 for use with the hard target weapon and/or as a product improvement to other standoff air-to-surface weapons. Complete ground test and begin captive flight test of the low cost tactical laser radar seeker. Laser radar ranging provides the seeker capability in low contrast conditions, allowing greater flexibility in employment. Additionally, this enhanced seeker will provide for target classification and identification. The seeker is being designed for low cost and is to be provided as an improvement to existing and developmental weapons without sacrificing affordability. Initiate development efforts for a multimission air-to-surface

guidance system. This effort will result in a more cost effective, advanced countermeasure resistant guidance capability for defeat of multiple sets of surface targets.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not Applicable.

10. (U) COOPERATIVE AGREEMENTS: Not Applicable

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63605F   Title: Advanced Weapon Technology
DOD Mission Area: 554 - Directed Energy Technology (ATD)   Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	16,474	23,082	29,076	34,766	Continuing	N/A
3150	Laser Device Technology	3,056	1,041	0*	0	*	*
3150	High Energy Laser Technology	0	0	3,576	2,200	Continuing	N/A
3151	Optics & Beam Control Technology	12,669	21,541	0*	0	*	*
3151	PILOT	0	0	18,750	21,650	Continuing	N/A
3152	Technology Development Support	749	500	0*	0	*	*
3152	High Power Microwave Technology	0	0	6,750	9,700	Continuing	N/A
3277	Aeronautical & Missile System Survivability**	0	0	0	550	Continuing	N/A
3278	Ground-Based System Survivability**	0	0	0	666	Continuing	N/A

* Beginning in FY 1988 these three projects in this Program Element have been retitled and the content rearranged.
** For FY 1989, projects originally planned for PE 63453F, Nuclear Survivability Systems, have been included in this PE.

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This is the Air Force Science and Technology Program which develops and demonstrates directed energy weapon (DEW) technologies for use in Air Force tactical applications and which also develops the technology for nuclear survivable systems. Recent advances in several laser and microwave efforts coupled with the results of continuing technology application analyses indicate that directed energy weapons will have a high payoff in the broad range of Air Force tactical applications. The DEW program concentrates on specific components such as chemical laser devices; light weight, high power mirrors; and high power microwave sources as well as concepts such as the Phased Integrated Laser Optics Technology (PILOT) program. To provide the technology for the possible development of Air Force weapon systems this program will (1) establish the effectiveness of the directed energy weapon concept; (2) establish the technology for scaling to the required high intensity levels; (3) explore options to reduce the size and weight of weapon systems; and (4) investigate concepts to improve significantly potential system reliability and reduce acquisition time and costs. The efforts in this program do not duplicate tasks being conducted under the Strategic Defense Initiative. In response to increased threats to Air Force systems, new methods of hardening and testing against nuclear weapons effects will be designed and demonstrated for application to system development. All nuclear effects will be considered, including electromagnetic pulse, radiation, blast, shock, debris, and thermal, as they apply to various types of Air Force systems, including aircraft, missiles, communications, command, control, intelligence, satellites and ground facilities. Emphasis is on system nuclear survivability design and test techniques rather than individual component survivability. In addition to developing methods to design a survivable system, methods to maintain and measure system nuclear survivability during its lifetime will be developed.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
RDT&E	14,749	23,641	22,918	N/A	Continuing	N/A

EXPLANATION: (U) Funds were addded in FY 1986 for 25 kilowatt oxygen iodine laser demonstration. Funds were added in FY 1988 to support high priority nonlinear optics and imaging technologies. Funds were added in FY 1988 to begin advanced development efforts in high power microwaves (HPM).

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: This PE is part of the tactical directed energy weapon program coordinated by the Director for Military Systems Technology in the office of the Under Secretary of Defense for Research and Engineering. Related work is in: Air Force PE 62601F, Advanced Weapons, project 3326, Laser Applications and project 5797, Advanced Weapons; Army PE 62307A, Laser Weapon Technology; and Navy PE 62101N, Directed Energy Weapons. Work in this PE is coordinated extensively with the Strategic Defense Initiatives Program PE 63221C, Directed Energy Weapons. All high energy laser technology in PE 63221C is closely monitored and the technology with tactical applications is factored into developments in PE 63605F. Coordination with the Department of Energy is through the laboratory technical program reviews, exchange of technical reports, and cooperative efforts at the working level. The high power microwave effort is also coordinated closely with the following Air Force PEs: 62202F, Aerospace Biotechnology; 62204F, Aerospace Avionics; 63718F, Electronic Warfare Technology; 63749F, Command, Control, and Communications Countermeasures Advanced Systems; 64711F, Systems Survivability (Nuclear Effects); and 64747F, Electromagnetic Radiation Test Facilities. HPM technologies are also being explored in close cooperation with a number of non-Air Force agencies. These include the Army, Navy, and three of the national laboratories. The nuclear survivability program supports Air Force major system development and operation. Concepts selected for development under this program element have been defined and evaluated under PE 62601F/Project 8809, Nuclear Survivability/Vulnerability Technology and PE 62715H, Defense Nuclear Agency. System hardening developments under this program are transitioned to PE 64711F, System Survivability (Nuclear Effects) for engineering development. Electromagnetic Pulse (EMP) test techniques developed here are transitioned to PE 64747F/Project 1209, Nuclear Effects Test Facilities. Major accomplishments under this program may transition directly to system program offices or operating agencies.

6. (U) WORK PERFORMED BY: The Air Force Weapons Laboratory (AFWL), Kirtland Air Force Base, NM, manages this program. The top five contractors are: Rockwell Rocketdyne, Canoga Park, CA (3151); TRW, Redondo Beach, CA (3151); BDM, McLean, VA (3151); RCA, Moorestown, NJ (3151); and McDonell Douglas, St Louis, MO (3151). There are 16 additional contractors with contracts totaling $5.4 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 3150, High Energy Laser Technology. This project develops the components for a very efficient, short wavelength, high energy laser. High efficiency is directly related to the size and weight of the laser system. The requirementa for higher efficienciea and higher intensities in tactically useful systems demand shorter wavelength laser beams aince they can be focused to smaller spot sizes on target. Thus, primary emphasis is placed on developing the technology for a practical oxygen iodine chemical laser which operates at a near-infrared (almost visible) wavelength. Oxygen iodine chemical lasera offer significant promise for tactical applications because of their moderate size, high efficiency, excellent atmospheric propagation, and single wavelength output. The single wavelength output allows the laser energy to be focused even tighter on target and simplifies greatly the design and fabrication of both laser and beam control optics. During FY 1986 and FY 1987, this project will develop only the photon generating laser devices. For FY 1988 and beyond, optica and beam control components and concepts for these devices will transfer into this project from project 3151. In FY 1986, the hardware for a 25 kilowatt (kW) oxygen iodine laser was fabricated and in early FY 1987, the device will be operated. This laser type operates in a continuous wave mode; however, to make the maximum use of nonlinear optics control techniques, the device needs to operate in a repetitively pulsed mode. A demonstration of a 1kW pulsed oxygen iodine laser will occur in FY 1989. The most promising nonlinear optica technologies for use with near-infrared wavelength chemical lasers will transition from PE 62601F in FY 1988. These technologies will allow the use of nonlinear materials to correct nonuniformities in high energy laser beams and to facilitate combining multiple laser beams and pointing the beams. Beginning in FY 1988, a nonlinear optics pointing and tracking brassboard will be fabricated and then tested in FY 1989. Investigations in phased array telescopes will continue with a demonstration of imaging using four telescopes in FY 1988 and an image sharpening demonstration in FY 1989 using atmospheric disturbance cancellation. Phased array telescopes offer great promise for both high power beam projection and high resolution imagery because of the ability to use small, low cost, off-the-shelf telescopes and avoid dependence upon a single laser device. The high resolution capability is almost a fallout from the high power development. However, the imaging capability does not require a high power system.

B. Project: 3152, High Power Microwave Technology. Starting in FY 1988 this project will support the development of high power microwave (HPM) technologies. For FY 1986 and 1987, it supports the two laser technology development projects. It establishes and operates special experimental laser facilities and provides advanced laser diagnostic instrumentation. During FY 1986 and FY 1987, the optical fabrication and evaluation facilities were and will continue to be upgraded to provide a capability at visible and near-infrared wavelengths. In FY 1988, these efforts will transfer to project 3150, High Energy Laser Technology. Starting in FY 1988, this project's new objective will be to develop the technologies and a susceptibility data base. that will (1) identify potential vulnerabilities of United States Air Force weapon systems to HPM[ ] This objective will be accomplished by testing representative Air Force systems and subsystems in a variety of radio frequency (RF) environments to determine their susceptibilities for a spectrum of RF parameters. These tests will provide an understanding of the effects of multiple pulses at high power levels on Air Force sytems and how these effects scale relative to the single pulse data. Using the results of these experiments and analysis of the resulting data base, the potential impact of RF weapons on Air Force missions [ ]

can be determined. A series of increasingly complex tests is planned, culminating in full-scale tests as the required high power microwave (HPM) test facilities become operational. These tests will measure the susceptibilities of Air Force systems to threat level radio frequency (RF) signals

They will require laboratory RF source and associated test facilities that can produce the desired electric field environment and can properly diagnose this environment and the response of the weapon system to the RF radiation. In FY 1988, a repetitively pulsed power driver and associated high power RF device(s), designed and developed under PE 62601F, Advanced Weapons, will be used to conduct a series of effects tests on unhardened operational Air Force systems/subsystems. These unhardened assets will include, but not be limited to, the AIM-7E, AIM-7F, AIM-4F, and AIM-4G missile systems.

In FY 1989 effects testing of unhardened systems/subsystems, such as the AWC-9 infrared search and tracking system and Maverick missiles, will continue. These tests will be performed with a repetitively pulsed, high power amplifier developed under this PE from oscillator technology originally developed under PE 62601F. Simple hardware changes will allow variations in frequency, pulse width, and power output.

C. (U) Project 3277, Aeronautical and Missile System Survivability. This project starts in FY 1989. The objective is to develop methods alleviating high altitude nuclear effects on inflight aerospace systems, particularly aircraft and missiles. The primary nuclear environments which affect inflight systems are electromagnetic pulse (EMP), nuclear radiation and thermo-mechanical. Nuclear detonations degrade systems at long ranges through EMP induced electrical currents that flow throughout the system. These induced currents cause effects that range from upset to destruction of electronic circuits. Nuclear radiation causes similar effects in systems, but only at closer ranges to the nuclear detonation. Penetrating nuclear radiation causes electronic components to upset or burnout, depending upon the amount of radiation that reaches a component. Thermomechanical effects on systems are structural failures caused by uneven heating due to absorption of low energy, nonpenetrating nuclear radiation by the surface of the system. The largest shortfalls in required technology are protection against EMP; thus EMP effects on systems are emphasized first in this project. The existing EMP test facilities are lacking both high frequency and low frequency output to adequately simulate the high altitude EMP environment. Major redesign of the existing test equipment to alleviate these problems will begin in FY 1989. Many catastrophic upsets cannot be evaluated or do not appear on cockpit instruments under EMP test conditions. Direct sampling techniques of the standard aircraft data bus will be developed to detect EMP caused upsets during system test starting in FY 1989. Hardness verification and surveillance techniques to locate and isolate faults during operational maintenance will be developed starting in FY 1989. Emphasis will be on non-invasive techniques to test the EMP protection of aircraft and missile systems.

D. (U) Project: 3278, Ground-Based System Survivability. This project will develop methods to protect and test ground based Air Force systems against the effects of direct nuclear attack, starting in FY 1989. Emphasis is on mobile and fixed ground facilities such as missile silos, command centers and communication antennas that must survive nuclear environments including blast, shock, electromagnetic pulse (EMP), debris, radiation and thermal. Particular attention will be paid to these environments close to nuclear bursts. Blast and shock test techniques will be developed to validate the response of ground installations to nearby bursts resulting from more accurate nuclear threats. Particular blast and shock test requirements to be addressed are in-situ instrumentation, time resolved measurements and less expensive explosive initiators. The current capability for soil strain measurements is to measure the entire strain time history as one value. Strain responses are highly dependent upon time and need to be measured as a function of time to allow extrapolation from the best simulation conditions to the actual threat conditions. Time resolution strain gauges for the increased test environments simulating nearby bursts will be developed in FY 1989. Nuclear bursts close to a ground installation cause major damage by two blast and shock mechanisms: shear and displacement. Shear refers to two segments of material reacting independently in different directions. Displacements are the motion of large masses of material in one direction. Different techniques are required to protect sensitive components against the two types of motion. A generator to simulate shear waves caused by nearby nuclear bursts with hydraulic actuators will be built in FY 1989. EMP effects on the ground close to nuclear bursts are far more severe than the effects from high altitude bursts, but the effects cover relatively smaller areas, extending only a few miles from the burst point; however, they do extend much further from the nuclear burst than the blast and shock effects. The amount of electrical current produced by EMP from these nearby nuclear events is large enough to vaporize large power cables and cause electrical arcs through concrete structures. There is no test capability for EMP effects close to nuclear bursts so proven construction techniques safe from EMP effects cannot be developed. Simulation techniques for EMP caused by nuclear surface bursts will be developed, starting in FY 1989. Methods to alleviate the effects of EMP caused by nuclear surface bursts close to power lines and other external electrical conductors that enter protective structures will be developed, starting in FY 1989. The methods include adding passive electrical elements to the electrical conductors and active termination devices at the interface between the electrical conductors and the protective structure. Current antenna designs withstand EMP, but have not considered radiation and blast and shock as a threat. Development of ground based satellite transceiver antennas that withstand the high levels of blast and shock, EMP, and radiation from nearby nuclear surface bursts will begin in FY 1989.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3151, Phased Integrated Laser Optics Technology (PILOT)

A. Project Description: This project demonstrates the practicality of [ ] This concept was developed in-house. [ ] This technology could yield a [ ] Several specific approaches are being pursued. During FY 1986 and FY 1987, this project will also develop other optical technologies, and shift to only PILOT in FY 1988.

Program Element: 63605F | Title: Advanced Weapon Technology
DOD Mission Area: 554 - Directed Energy Technology (ATD) | Budget Activity: 2 - Advanced Technology Development

B. (U) Program Accomplishments and Future Efforts:

(1) FY 1986 Accomplishments: The Phased Integrated Laser Optics Technology (PILOT) program is the highest priority effort.

Preliminary application analysis of this technology have been completed. This analysis focused on both near- and long-term applications and will be used to direct the technology efforts. Several non-PILOT efforts also achieved significant milestones. Analysis and laboratory testing continued to evaluate the basic practicality and performance of optical phased array concepts. This work focuses on acquisition and surveillance for Air Force applications. An aperture sharing concept evaluation was completed. This will allow the weapon system to track the target in one wavelength region while the high power laser is operating at another wavelength. Studies on the application of various high energy laser technologies for Air Force ground-based laser systems have been completed. Design of a 150 actuator deformable mirror for beam control was completed and hardware efforts began.

(2) FY 1987 Program: The major effort will focus on PILOT.

These early efforts will establish technology practicality and performance

More detailed studies with emphasis on near term applications and transitions will begin. Other efforts will concentrate on high payoff laser components and concepts. This includes multiple phased array telescope imaging which will allow target discrimination. An aperture sharing element will be fabricated and tested for use in a short wavelength chemical laser. The phased array mirror technology coupled with the aperture sharing technology will allow the high power transmission system to be used for high resolution imaging.

(3) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: This project will include only PILOT for FY 1988 and beyond. The demonstration of an array of several subscale 2-D modules phase locked together will be completed. Coupled modules of this type could be used for long range communications and other applications requiring up to a few hundred watts. A program
will begin. This will pave the way for

This will produce

Devices of this limited size will have applications in optical radars, long-range communications, and several others. Since many applications will need a long range, efforts to evaluate the technology options will begin. These efforts will emphasize the development of system architectures and components which use the unique features of the PILOT concept to the best advantage,

Studies will continue on the optimum usages of this technology. These studies will consistently feed the technology efforts to ensure that all practical applications are considered,

that systems oriented guidance is provided to the technology development efforts, and that technology transition to specific systems development is supported. There will also be programs to look at other aspects of this technology.

(4) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The technology demonstration [ ] will be completed. Also, the effort to fabricate [ ] will be completed. These efforts will form the key building block for transition [ ] Based on the results of the previous and ongoing efforts in this project, [ ] Transitioning ongoing efforts in this technology to the many users will be continued.

(5) Program to Completion: This is a continuing program. [ ] Transitioning of the technology will continue.

C. (U) Major Milestones:

Milestones	Dates
(1) ( ) [	[
(2) ( )]	]

9. (U) COOPERATIVE AGREEMENTS: Not applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63707F Title: Weather Systems
DOD Mission Area: 420 - Global Military Environmental Support Budget Activity: 2 - Adv Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		3,146	3,187	5,276	5,838	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Program Element funds advanced development of weather systems that, when fielded, will eliminate critical shortfalls in weather support to Air Force and Army operations. The following efforts are included: (a) Battlefield Weather Observation and Forecast System: The Air Force critically needs the ability to observe and collect essential weather information in battle areas not under friendly control. Employment of precision guided munitions requires specific environmental information which is unique to the weapon's sensing systems and which is not available through present weather observing and forecasting techniques. This program develops methods to gather this vital weather information and process it for use by battle staff planners and aircrews in the effective battlefield employment of precision guided munitions. It provides a key to optimizing force effectiveness during adverse weather conditions. (b) Algorithm Development for Next Generation Weather Radar (NEXRAD): This work supports the development of a Doppler weather radar capability. Timely warning for specific severe weather events is required to protect Air Force assets. Doppler weather radar provides the ability to detect severe weather phenomena. Automated analysis techniques are required to process this information in a timely manner to provide effective warning. This program provides joint Department of Defense, Department of Transportation, and Department of Commerce NEXRAD development. (c) Automated Weather Distribution System-Automated Observation Subsystem: The Air Force has a need to automatically sense, collect, disseminate and display the local weather conditions in real time to air traffic control facilities and operational units. Several key weather elements -- clouds, visibility, and present weather/obstruction to vision -- cannot be automatically sensed with current technology. This program develops the technology to automatically sense these critical weather parameters. When fielded, this program will provide real-time alerting of key weather events and will reduce weather support manpower requirements. (d) Technology Transition: The Air Force has the need to improve weather support to keep pace with the support requirements and environmental sensitivities of emerging technologies in new weapon systems. This program transitions improved and new support techniques from technology development into operational support software. Techniques within this program include: improved vertical atmospheric analysis, improved cloud analysis and forecasting, a new magnetospheric model, and an improved ionospheric forecast model.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	3,375	3,697	4,102	N/A	Continuing	N/A

Program Element: 63707F — Title: Weather Systems
DOD Mission Area: 420 - Global Military Environmental Support — Budget Activity: 2 - Adv Technology Development

EXPLANATION: (U) A zero balance transfer of FY 1988 funds from PE 64707F was made to provide required funding for the advanced development of the battlefield weather observation sensor and forecast techniques, as well as the development of automated weather observation sensors for lightning, clouds, visibility, and present weather/obstruction to vision.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: Results of advanced development efforts in this program element are implemented through Program Element 64707F, Weather Systems (Engineering Development) and Program Element 35111F, Weather Service (Other Procurement). Specifically, results of the Battlefield Weather Observation and Forecast System (BWOFS) and the Automated Weather Distribution System-Automated Observation Subsystem (AWDS-AOS) will undergo engineering development in PE 64707F. The Next Generation Weather Radar (NEXRAD) development (PE 64707F) will directly use automated severe weather forecast techniques developed in this program element. The 1986 Science and Technology Program Review to the Under Secretary of Defense for Research and Engineering provided a forum for tri-service coordination of efforts in battlefield forecasting techniques. The Department of Defense Atmospheric Transmission Plan is the focal point for support of precision guided munitions delivery. Working level contact with the Army and Navy continues, avoiding unnecessary parallel development of techniques and systems.

6. (U) WORK PERFORMED BY: Program management is provided by the Air Force Geophysics Laboratory (AFGL), Hanscom AFB, MA. The BWOFS program has program participation by Air Force Wright Aeronautical Laboratories, Wright-Patterson AFB, OH. Principal contractors are SASC Technologies Incorporated, Riverdale, MD; Battelle Columbus Laboratories, Columbus, OH; and Georgia Institute of Technology, Atlanta, GA. AWDS-AOS development contracts are with the University of California at San Diego, the University of Washington, and HSS Incorporated, Bedford, MA. All NEXRAD work is currently performed in-house at AFGL.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 63707F, Weather Systems (Advanced Development)

A. (U) Project Description: BWOFS: Develops the ability to acquire and process weather information required by battle commanders and pilots to employ precision guided munitions effectively. The Air Force has no capability to gather or process tactical environmental information in denied areas, yet this information is critical to the effectiveness of today's high technology weapons. Algorithm Development for NEXRAD: Develops a set of Doppler weather radar diagnostic algorithms for the automated and early detection and warning of severe storm related wind and precipitation related threats to Air Force operations and facilities. These techniques will meet the operational requirements of the forthcoming NEXRAD system. AWDS-AOS: Develops the technology to automatically sense critical weather parameters and provide real-time alerting of key weather events. Technology Transition: Validates new environmental analysis and prediction techniques for operational use to meet evolving support requirements of modern Air Force weapon systems. The program includes both meteorological and space environmental analysis and forecasting methods.

5. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Battlefield Weather Observation and Forecast System (BWOFS): Improved calculator versions of Tactical Decision Aids (TDAs) for infrared (IR), television (TV), low-light level TV, and laser designator systems were developed and tested. A microcomputer version of these TDAs was developed. Work began on TDAs for Night Vision Goggles and Navigation Systems, and on the software architecture to support an automated composite TDA. The composite TDA will combine all TDAs into one package to facilitate multi-weapon systems employment planning. Development of prototype weather observation sensors for the Unmanned Air Reconnaissance System (UARS) continued and system integration began. Algorithm Development for Next Generation Weather Radar (NEXRAD): The downburst wind detection algorithm was developed and tested. Also, storm severity indicators were evaluated as solutions to validated severe storm warning requirements. Automated Weather Distribution System-Automated Observation Subsystem (AWDS-AOS): Development of prototype sensors for visibility and comparative testing of two competing present weather sensors began. Technology Transition: Development began on an improved Proton Prediction System to correct the current deficiencies in predicting very high energy protons arriving at the earth.

(2) (U) FY 1987 Program: BWOFS: An initial composite TDA for the standard Air Force microcomputer will be fielded. Development of TDAs for Night Vision Goggles and Navigation Systems will continue. Advanced development of the composite TDA will be completed, and the effort will transition to engineering development. The battlefield weather observing system, the UARS weather sensor package, will enter system concept validation. Algorithm Development for NEXRAD: Preplanned algorithm improvements will be developed to enhance detection and analysis of downbursts and tropical cyclones. AWDS-AOS: Integration of off-the-shelf meteorological sensor technology (e.g., lightning detection system) and development of additional new sensors will continue. Technology Transition: Improved vertical atmospheric analysis techniques for temperature, pressure, water vapor, aerosol size distribution and density, as well as surface visibility will be tested and validated. The Proton Prediction System will be fielded.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: BWOFS: Key high value target models will be added to the IR TDA. Night Vision Goggles and Navigation Systems TDAs will be fielded. The composite TDA for standard Air Force microcomputers will be fielded. Concept validation of the UARS weather observation sensor package will continue. Algorithm Development for NEXRAD: Preplanned algorithm improvements for hail, tornadoes, wind shear, and turbulence will be developed. A precipitation prediction algorithm will be completed. In addition, any algorithm deficiencies identified during Initial Operational Test and Evaluation will be corrected. AWDS-AOS: Development of visibility and cloud cover sensors will continue. A prototype sensor for present weather will be selected. A lightning detection/location system will be evaluated. Technology Transition: Validation of improved vertical atmospheric analysis techniques for temperature, pressure, water vapor, aerosol size distribution and density, as well as surface visibility will continue. Operational testing of improved cloud analysis and forecasting techniques will begin. The funding request is based on awarded, ongoing contracts, contractor proposals, or contractor estimates. The confidence in the cost estimates ranges from Comprehensive (Level I) to Budget (Level III) depending on the maturity of the individual effort. Last comprehensive review of the cost estimate was completed in July 1986.

Program Element: 63707F Title: Weather Systems
DoD Mission Area: 520 - Global Military Environmental Support Budget Activity: 2 - Adv Technology Development

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Battlefield Weather Observation and Forecast System (BWOFS): The development of Tactical Decision Aids (TDAs) to support millimeter wave and other laser systems will begin. Additional sensors, targets, and backgrounds will be incorporated in the Infrared TDA to significantly increase its applicability worldwide. Concept validation of the weather observation sensor package for the Unmanned Air Reconnaissance System will be completed. This sensor effort will transition to engineering development. Algorithm Development for Next Generation Weather Radar (NEXRAD): The development of preplanned algorithm improvements for severe weather detection will continue. Automated Weather Distribution System-Automated Observation Subsystem (AWDS-AOS): The automated visibility sensor development will continue with emphasis on algorithm improvement and all-weather operation. The cloud sensor design effort will be completed and a contract for a prototype automated cloud sensor will be initiated. Technology Transition: Operational testing of improved vertical atmospheric analysis techniques will begin. Validation of algorithms for improved ionospheric, stratospheric, and neutral density models will begin. The funding request is based on awarded, ongoing contracts, contractor proposals, or contractor estimates. The confidence in the cost estimates ranges from Comprehensive (Level I) to Budget (Level III) depending on the maturity of the individual effort. Last comprehensive review of the cost estimate was completed in July 1986.

(5) (U) **Program to Completion:** This is a continuing program.

C. (U) **Major Milestones:**

		Milestones		Dates
(1)	(U)	BWOFS	Program Initiation	October 1980
(2)	(U)	NEXRAD	Program Initiation	October 1980
(3)	(U)	BWOFS	Infrared Tactical Decision Aid (TDA) Operational	October 1983
(4)	(U)	AWDS-AOS	Program Initiation	October 1983
(5)	(U)	BWOFS	Development of TV and 1.06 Micron Laser TDAs Fielded	June 1984
(6)	(U)	NEXRAD	Initial Algorithms Delivered to Joint Program Office	July 1985
(7)	(U)	BWOFS	Observation Subsystem Sensors Testing Complete	September 1985
(8)	(U)	AWDS-AOS	Initial Prototype Sensor Contract Award	September 1985
(9)	(U)	Tech Transition	Proton Prediction System Development Complete	December 1987
(10)	(U)	BWOFS	Composite TDA Advanced Development Complete	September 1987
(11)	(U)	AWDS-AOS	Selection of Lightning Prototype Sensor	December 1987
(12)	(U)	BWOFS	Integrated TDA for Standard AF Microcomputers	December 1987
(13)	(U)	BWOFS	Upgraded TDAs for Infrared and Laser Systems Fielded	December 1987
(14)	(U)	BWOFS	Night Vision Goggles and Navigation Systems TDAs Operational	August 1988
(15)	(U)	AWDS-AOS	Selection of Present Weather Prototype Sensor	September 1988
(16)	(U)	BWOFS	Observing System Testing Complete *(FY 1988)	March 1989
(17)	(U)	NEXRAD	Upgraded Algorithms for Hail, Tornadoes, Wind Shear, and Turbulence Complete	September 1989
(18)	(U)	NEXRAD	Initial Operations Capability Including Algorithms	September 1989

Program Element: 63707F — Title: Weather Systems

DOD Mission Area: 420 - Global Military Environmental Support — Budget Activity: 2 - Adv Technology Development

		Milestones		Dates
(19)	(U)	AWDS-AOS	Automated Prevailing Visibility Prototype Sensor Complete	September 1990
(20)	(U)	BWOFS	Operational TDA for Other Laser Systems Complete	January 1991
(21)	(U)	BWOFS	Operational TDA for Millimeter Wave Systems Complete	June 1991

* Date presented in FY 1987 Descriptive Summary

(U) Explanation of Milestone Change

(16) (U) Completion of the concept validation for the Unmanned Air Reconnaissance System weather observation sensor slipped 6 months because Congress reduced FY 1986 funding by $0.5 million. This funding cut delayed the start of concept validation by 6 months.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not applicable.

9. (U) COOPERATIVE AGREEMENTS: Not applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63723F — Title: Civil and Environmental Engineering Technology
DOD Mission Area: 553 - Engineering Technology (ATD) — Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	8,743	13,318	11,342	11,324	Continuing	N/A
2103	Environmental Quality Technology	3,145	1,883	1,800	1,806	Continuing	N/A
2104	Civil Engineering Technology	4,055	7,284	6,765	6,752	Continuing	N/A
2672	Special Terrestrial Power	266	400	0	0	0	1,975
3037	Noise and Sonic Boom Impact Technology	565	2,897	2,777	2,766	6,303	15,780
3139	Alaskan/Remote Site Fuel Cell	712	854	0	0	0	6,025

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Science & Technology program provides the technology to speed the recovery of an airbase after an enemy attack, to reduce the operating and maintenance costs of an airbase, and to minimize the environmental impact from Air Force operations. These goals are achieved through advanced research to: develop survivable air base structures and expedient facility and utility repair techniques; optimize runway pavement maintenance and recycling techniques; develop fire fighting agents and equipment; test and evaluate techniques that reduce Air Force pollutant emissions, correct environmental problems discovered during weapon system development, and reduce the cost and amount of hazardous waste disposal; assess and predict the noise and sonic boom impacts from aircraft operations; and develop mobile and remote site electrical energy systems.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	11,488	16,453	16,381	N/A	Continuing	N/A

EXPLANATION: (U) The FY 86 through FY 88 reductions resulted from a transfer of Defense Environmental Restoration Program funds to a central transfer account, and an overall reduction to meet Total Obligation Authority constraints.

4. (U) OTHER APPROPRIATION FUNDS: Not applicable.

5. (U) RELATED ACTIVITIES: The efforts within this program are of significant interest to the other services and are coordinated through the Joint Services Civil Engineering Research and Development Coordinating Group, which guards against duplicating efforts and works to maximize technology transfer. All Air Force efforts in environmental quality R&D are reviewed annually by the Office of the Under Secretary of Defense for Research and Engineering to preclude duplication within the military services and between the services and other agencies. For sonic boom issues, the Air

Force has been designated lead service. Efforts of civilian or national interest are coordinated as appropriate with the Federal Aviation Administration, National Aeronautics and Space Administration, Environmental Protection Agency, and the National Academy of Science. The Air Force and the Navy have a memorandum of agreement to conduct joint programs for aircraft fire suppression and crash rescue. This program funds efforts that transition into PE 64708F, Other Operational Equipment, and PE 64617F, Air Base Survivability. Additionally, PE 62206F, Civil Engineering and Environmental Quality, funds exploratory development in environmental quality and civil engineering technology; PE 62203F, Aerospace Propulsion, funds exploratory development in power generation and energy conversion technology; and PE 62202F, Aerospace Biotechnology, funds exploratory development of technology to determine aircraft noise and sonic boom effects.

6. (U) WORK PERFORMED BY: In-house and contractual efforts are conducted by the Engineering and Services Laboratory, Air Force Engineering and Services Center, Tyndall AFB, FL; Aero Propulsion Laboratory, Wright-Patterson AFB, OH; and Aerospace Medical Division's Armstrong Aerospace Medical Research Laboratory, Wright-Patterson AFB, OH. Other government resources are used, including those of the Departments of the Army, Navy, and Energy, the Bureau of Mines, Oak Ridge National Laboratory, the Environmental Protection Agency, the National Aeronautics and Space Administration, and the Federal Aviation Administration. The top five contractors and associated projects are BDM Corporation, McLean, VA (2104); Ensco Inc., White Bluff, TN (2103); New Mexico Engineering Research Institute, Albuquerque, NM (2104); R.M. Parsons, Incorporated, Pasadena, CA (3139); and Dynamac Corp., Rockville, MD (2103 & 3037). There are 23 other contractors with a total dollar value of $8.5 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 2103, Environmental Quality Technology. This project tests and evaluates technologies for solving problems of environmental restoration, weapon systems emissions, industrial waste treatment, and toxic pollutant releases from Air Force operations. Increasingly stringent environmental laws require Air Force weapon systems and support operations to comply with numerous environmental considerations. Mission accomplishment can be impaired or stopped if the Air Force doesn't meet the regulatory standards. The technologies tested and evaluated in this project help the Air Force comply with environmental regulations and minimize the impact of Air Force operations. FY 1986 accomplishments. The following work was completed: pilot-scale testing with the Environmental Protection Agency of a low-cost cleanup treatment technique to wash out hazardous chemicals from contaminated landfills; testing of incineration technology to safely dispose of contaminated fire suppressant foam from the fuel tanks of C-130, F-4, F-15, and A-10 aircraft, reducing disposal costs by over 20%; a field test of fuel additives to reduce soot emissions from jet engine test facilities, thereby allowing bases to meet local air quality standards; and the development of a prototype instrument to allow base personnel to measure trace concentrations of trichlorethylene, one of the Air Force's most widespread contaminants. A field test of a cleanup technology for jet fuel contaminated groundwater and soil was initiated. Planned work for FY 1987. The following will be completed: field tests of a stand-off sensor to detect hazardous chemical emissions from waste sites, thus reducing the risk to monitoring personnel; and the integration of two computer models to predict the atmospheric concentrations of components formed when jet fuel is [illegible] the air. The following will be initiated: development of a model to predict the atmospheric dispersion of toxic chemicals resulting from an explosion of a rocket during launch; and a joint study with the Environmental Protection Agency to test technologies to minimize the amount of hazardous chemicals emitted to the atmosphere from Air Force maintenance

operations. Planned work for FY 1988. The following will be completed: development of a waste minimization method to separate paint residue from the plastic pellets that blast the paint off of an aircraft during major overhauls; and the development of a procedure to validate future toxic gas dispersion models. The following will be initiated: development of an instrument for the real-time measurement of soot particles from jet engine exhaust; studies to reduce the emission of corrosive hydrochloric acid generated during the launch of Titan rockets; tests of a hazardous waste minimization technique in which a hazardous material (cadmium) is replaced by a safer one (aluminum) in the process that protects aircraft components from corrosion; tests of treatment technologies for the disposal of new liquid and solid rocket fuels; and testing of a technique to verify that a hazardous chemical can be safely incinerated, thereby decreasing the cost of monitoring the incinerator exhaust. Planned work for FY 1989. The following will be completed: development of a model to predict the atmospheric concentration of emissions from disposing of solid rocket fuel by open burning; an evaluation of a field test kit to characterize the quality of solvents used to clean aircraft components; an environmental assessment of a suppressant foam for missile fuel fires; and testing of a device that directly samples and identifies the particular chemicals in atmosphere contaminated with several hazardous chemicals. The following will be initiated: field tests of methods to reduce the volume of hazardous wastes generated from testing bullets containing depleted uranium; and a study of the environmental hazard of composite material fibers released from aircraft maintenance.

B. (U) Project: 2104, Civil Engineering Technology. This project tests and evaluates advanced technologies to build survivable facilities, construct and repair runways, and fight aircraft and post-attack fires. Facility and utility research allows critical base structures, such as aircraft shelters and power stations, to survive conventional weapon attacks and still function. Recent readiness exercises showed that airbase utility (power) systems are particularly vulnerable and are difficult, if not impossible, to repair expediently. Airfield pavement development helps reduce the $100 million annual cost of maintaining Air Force runways and pavements, 92% of which now exceed their original 20 year design life. Fire technology supports over 13,000 Air Force fire fighters by improving the capability to put out fires in military-specific situations, such as in the presence of munitions or chemical warfare agents. FY 1986 accomplishments. The following work was completed: design of a brighter light source for a portable runway lighting system; development of a computer model that calculates the reactions of a loaded KC-135 aerial tanker as it rolls over repaired runways; development of a system that determines pavement properties and eliminates the need to drill holes in the pavement; development of new fire fighter clothing ensemble that provides protection against chemical warfare agents; and testing of a new fire suppression foam for missile fuels. Planned work for FY 1987. Limited field tests will be conducted to evaluate the rutting of asphalt pavement caused by high pressure aircraft tires (initial estimates show a loaded F-15C/D aircraft reduces the life of asphalt pavement by 50 percent). The following will be initiated: development of an expedient repair capability using new methods and materials for post-attack recovery of utilities; tests to determine safe personnel exposure limits to halon (a fire suppressant) in order to prevent accidental injury to firefighters during training exercises; simplification of a computer model that combines enemy attack capabilities and the layout of an airbase to predict post-attack damage, thus allowing more bases to prepare for post-attack recovery; development of safety standards and construction techniques for building hyperbaric facilities (which treat various medical conditions with high pressure oxygen) out of concrete instead of the currently used steel, which will reduce construction costs by 40 percent; enhancement of the current capability to test the effects of gravity on model structures; and a study of the reaction of structures built on pilings to the forces from nearby explosions (most aircraft shelters in the Pacific are built on pilings); and development of a procedure that allows field engineers to assess

the ability of various pavements to support contingency operations. Planned work for FY 1988. The following will be completed: development of blast absorbing systems that protect existing facilities at costs less than systems currently used; and development of an aircraft fire sentry that detects and suppresses fires in storage areas of parked cargo aircraft. The following will be initiated: a study of the improved performance of pavements reinforced with fibers; a study of additives to improve the performance of asphalt (reduce the wear from thrust-vectored engines and reduce the pavement rutting from high pressure aircraft tires); development of an aircraft support system that provides fuel and electricity to parked aircraft via underground distribution networks, thereby reducing the need for mobile support equipment carts; and the design of add-on armor to protect fire fighting equipment from damage during post-attack operations (the loss of even one fire truck seriously slows a base's recovery). Planned work for FY 1989. The following will be completed: investigation of steel, polypropylene, and other materials used in reinforced pavements to reduce rutting and cracking; studies of the survivability and repair of utilities; development of an advanced aircraft rescue vehicle that allows fire fighters to reach aircraft that crash on unprepared surfaces adjacent to pavement (current trucks bog down); and development of a transportable, blast-resistant structure that can also be used as a permanent structure. The following will be initiated: development of pavements that resist heat from thrust-vectored jet engine exhausts; development of a mobile air conditioning unit that quickly cools large, vital base facilities, such as avionic repair shops or computer centers (existing emergency units are designed to cool aircraft, not facilities); and field validation of an analytical model that predicts the rutting of asphalt due to high pressure tires.

C. (U) Project 2672, Special Terrestrial Power. This project meets special Air Force ground-based electric power needs by developing and adapting advanced heat engine technology. Advanced heat engines offer performance, life cycle cost, and field logistic advantages over conventional diesel and gasoline generators. A joint Air Force/Army effort is developing a 3 kilowatt (kw) free-piston Stirling engine (FPSE) power system for mobile applications. A Stirling engine uses heat from an external source rather than internal combustion. The heat comes from the external burning any of several military fuels, thus reducing the field logistic requirements. The Air Force requires improved power sources for tactical air control parties and combat control teams currently using batteries and gasoline generators. Gasoline generators are being phased out because they do not use diesel fuel, and the diesel generators replacing them are noisy and heavy. FY 1986 accomplishments. Several FPSE major subsystems were developed, including the fuel burner, microprocessor control, and alternator. The engine worked successfully using helium to transfer the heat generated by burning the fuel. Work began to modify the engine to use air instead of helium to reduce field logistics problems. In FY 1987, a power system using the FPSE will be developed and fabricated, and limited tests will be conducted by the Army.

D. (U) Project: 3037, Noise and Sonic Boom Impact Technology. This project develops an assessment and prediction capability to evaluate environmental impacts on humans, animals, and structures of noise from subsonic and supersonic aircraft operations. The military has the unique requirement to fly aircraft at high subsonic speeds at low altitudes, and at supersonic speeds at any altitude. To meet this requirement, air bases, training routes, and operating areas must be assessed for potential environmental impacts. A typical noise assessment currently takes from two to five years to accomplish because of the lack of scientifically credible data and methodologies to quantitatively address the impacts. Improving this capability is essential in order to prepare accurate environmental impact statements, reduce the effects of aircraft noise, and respond to public concerns in a responsible and timely fashion. The Air Force is the lead service for conducting noise research to enable full compliance with the National Environmental Protection Act. FY 1986 accom-

plishments. A sonic boom prediction model was expanded to include additional combat scenarios of fighter aircraft and data from instrumented military operating areas. The model will predict the sound overpressures and distribution of sonic booms in existing or proposed supersonic airspaces. A monitoring program was started to determine the long-term effects of noise on an archeological site under a strategic aircraft training route. Sonic boom recorders were developed and field tested for use as unattended boom monitors. The recorders dramatically increase the amount and quality of data while cutting manpower requirements in half. Planned work for FY 1987. The development will begin of a storage and retrieval system for noise effects information used by environmental planners. Data from previous aircraft noise research on humans and animals will be included in the information system. Research will begin on determining and modeling noise effects on humans and animals. Existing models that predict the reactions of conventional structures will be evaluated and modified to develop long-term prediction methodology for given noise and sonic boom loadings. The sonic boom prediction model will be validated with measured data from an instrumented operating area. Planned work for FY 1988. The sonic boom prediction model will be transitioned to environmental planners for use in noise assessments. The model will predict the effects of single aircraft missions, an improvement to the FY 1986 capability of only calculating the effects of cumulative aircraft missions. The information storage and retrieval system will be provided to environmental planners for critical evaluation. The system will relate predicted overpressures to effects on humans, animals, and conventional structures. A methodology will be developed that addresses the sonic boom impact on non-conventional soils and structures (that are areas of concern in current environmental impact assessments) such as avalanches and national monuments. Planned work for FY 1989. A method will be developed to determine the effectiveness of on-base jet engine noise suppression systems. Currently, no objective criteria exist for determining their ability to reduce the noise impacts on the base population or the surrounding civilian community. Environmental planning methods will be integrated with the noise information retrieval system to estimate noise impacts even with limited site data, providing a basis for further quantitative environmental assessment.

E. (U) Project: 3139, Alaskan/Remote Site Fuel Cell. This project evaluated fuel cell power generators for Air Force remote sites. The fuel cell technology was an alternative to conventional diesel power systems currently used in remote sites. A fuel cell is a device that generates electrical power by reacting hydrogen, usually from a petroleum fuel, and oxygen through a chemical solution, such as phosphoric acid. Data obtained by operating 40 kilowatt (kw) phosphoric acid fuel cells (PAFC) developed by the Department of Energy (DOE), and data from other available sources were evaluated to determine the feasibility of developing more powerful PAFCs for military applications. FY 1986 accomplishments. Forty kw fuel cell power generators developed by DOE were operated at Elmendorf AFB and three other sites. Operation, maintenance, and performance data were collected. Evaluations were completed for three fuel processing methods to separate hydrogen from petroleum fuel. A life cycle cost model was developed to predict PAFC performance. A study of remote site power requirements and conditions was continued. Planned work for FY 1987. The data collection at Elmendorf and the other sites concluded. The technical approach for this development program was reassessed after updated life cycle cost figures were determined. Due to the high life cycle costs for PAFCs (compared to modern diesels) and other technical reasons, development of the PAFCs was discontinued.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not applicable.

9. (U) COOPERATIVE AGREEMENTS: Not applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63726F
DOD Mission Area: 345 - Tactical Communications

Title: Command Control Communications and Intelligence Subsystem Integration
Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	*4,866	*6,368	8,608	9,634	Continuing	N/A
2478	Tactical C^3 Architecture	447	400	099	904	Continuing	N/A
2810	Digital Mapping/Charting	1,276	1,660	1,603	1,768	Continuing	N/A
2863	Fiber Optics Development	3,143	2,764	4,424	4,000	Continuing	N/A
3192	Tactical Optical Disk	0	1,544	2,482	2,962	Continuing	N/A

*Prior years reflect FY 1988 science and technology restructure for comparibility purposes only.

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The mobile elements of the Tactical Air Control System (TACS) must be capable of separating their associated operations centers away from radio frequency (RF) emitters to maximize survivability and operational flexibility. Also, the weight, cost and bulk restrictions of present interconnecting cable systems cause significant degradation to the mobility and flexibility of tactical systems. Fiber optics have been demonstrated to provide substantial increases in remoting distances for RF emitters with greatly reduced weight and cost. A further benefit is the reduction in bulk of the extensive cabling associated with TACS elements. This program provides the advance development of fiber optics systems designed to meet these requirements. Also included is the definition of standards to provide interoperability between Air Force systems and the systems of the other Services, and to prevent the proliferation of nonstandard equipment. The Tactical Optical Disk System (TODS) project will accommodate multi-sensor inputs to intelligence exploitation systems. The Cartographic Applications for Tactical and Strategic Systems (CATSS) project will provide digitized data bases needed for navigation, targeting and weapons delivery functions of current and future weapons systems. It will allow the Defense Mapping Agency to concentrate on refinement of terrain coverage and on maintaining currency of world-wide navigational features.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	3,373	2,841	3,824	N/A	Continuing	N/A

EXPLANATION: Overall increase in advanced technology programs; specifically transfer of project 3192 (TODS) from PE 63789F and project 2810 (CATSS) from PE 63259F in FY 88 accounts for this increase.

4. (U) OTHER APPROPRIATION FUNDS: Not applicable.

5. (U) RELATED ACTIVITIES: The efforts in this program element include transition of technology developed under PE 62702F, Command, Control, and Communications and from PE 63789F, advanced computer technology. Efforts within the Air Force are coordinated by the Air Force Fiber Optics Working Group. Coordination between the Services is through the tri-Service Fiber Optic Coordinating Group. Systems for tactical communications will be transitioned to PE 28010F, Joint Tactical Communications for full scale development.

6. (U) WORK PERFORMED BY: Air Force Systems Command manages this program through Rome Air Development Center, Griffiss AFB, NY. The current contractors are: GTE Sylvania, Needham, MA, Tactical Generic Cable Replacement (TGCR); TRW, El Segundo, CA, TGCR; RCA, Camden, NJ, Standard Family of Transceivers; Harris Corporation, Meldourne, FL and PAR Technology, New Hartford, NY (Data Base Structures); Grumman Data Systems Corporation, Woodbury, NY and Illinois Institute of Technology Research Institute, Chicago, IL (Functional software definition and sensitiuity modeling).

7. (U) PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 2863, Fiber Optics Development: The Tactical Generic Cable Replacement (TGCR) system will replace all 26 pair copper cable with fiber optics. This development is a joint effort with the U.S. Army. The TGCR senses the electronic interface on each of 26 pairs, converts the signal to light, and communicates over 6 kilometers of optical fiber. The standardized family of optical transceivers will significantly reduce life cycle costs and proliferation of fiber optics based subsystems. This program is the Air Force response to the Joint Service Common Elector-Optic Module program directed by the Deputy Under Secretary of Defense for Research and Advanced Technology. A standard family of fiber optic transceivers for local area networks (LAN) will provide standardized multi-mode fiber optic systems for LANs. A Radar Remoting Applique (RRA) will extend the fiber optics remoting capability, without a repeater, of radars to 10 kilometers. This program will take advantage of wavelength division multiplex technology developed in exploratory development (PE 62702F) to provide interoperability between existing remoting systems and to meet the full radar remoting requirements of the Tactical Air Forces (TAF). A near-term Tactical Intrusion Resistant Optical Communication System (TAC-IROCS) will build on technology developed for fixed plant application in FY 1984. The system will demonstrate how classified traffic can be communicated without encryption devices over optical fiber protected by intrusion sensing technology developed in this program. An advanced IROCS program will provide high bit rate, wide bandwidth protection over graded index fiber (versus lower bit rate step index fiber) and will introduce the capabilities for IROCS on bus systems with less than five ports. The Optical Multiplexer Family will provide small, low cost alternatives to large, power consumptive digital multiplexers. A multi-gigahertz analog communications program will be designed to provide waveguide alternatives at radio frequencies from 1 GHz ultimately to 60 GHz. In FY 86, the TGCR advanced development was completed. Work continued on the Standard Family of Optical Transceivers. The RRA design phase was initiated.

In 1987, the Standard Fiber Optics Transceivers program will be completed. The fabrication phase of Standard Local Are Network Fiber Optic Transceivers (LANFOX) will begin this year. The RRA program will be completed. The TAC-IROCS pro-

gram will move into the hardware fabrication phase.

FY 1988 Planned Program and Basis for FY 1988 RDT&E Request is initiation of the advanced Intrusion Resistant Optical Cable System (IROCS) program, the optical multiplexer family, and the multi-gigahertz analog communications program design. The Radar Remoting Applique advanced develoment will be completed. Budgetary Category III cost estimating techniques were applied in program review by program office in August 1986.

FY 1989 Planned Program and Basis for FY 1989 RDT&E Request covers continued design of advanced Intrusion Resistant Optical Cable System (IROCS), the optical multi-plexer family, and the multi-gigahertz analog communications program. Category III Budgetary Cost - estimating techniques were applied by the program office in August 1986. This is a continuing program driven by advanges in Fiber Optics applications/requirements.

B. (U) Project: 3192, Tactical Optical Disk System. This project transferred to this PE from PE63728F. The Tactical Optical Disk System (TODS) project will design, deliver and test an integrated suite of digital optical disk systems that have been ruggedized and made transportable. TODS equipment will include a 10-disk automated recorder/player, a single disk recorder/player and a desk top/rack mounted play only unit. These digital optical disks will provide the capability to improve data storage and retrieval capability, storage density and data capture rates by 2-3 orders of magnitude over present magnetic disk and tape systems. The Tactical Optical Disk System (TODS) capability is required to deal with the real time and near-real time multi-sensor inputs to intelligence exploitation systems such as the TR-1 Ground Station and Strategic Air Command (SAC) deployable C^2 center, the SAC Headquarters Emergency Relocation Team, and the Electronic Systems Division Advanced Deployable Digital Information Support System. In FY 1986, under Air Force exploratory Development (62702F) funding, the basic design and development of a ruggedized optical disk system has taken place. Primary emphasis was placed on miniaturization and ruggedization of the optics. The resultant breadboard system has a 4x reduction in overall optical system size while maintaining the performance requirements of the much larger benign environment systems. The total system envelope is approximately three cubic feet or 12 vertical inches of rack space. The latter portion of FY 1986 was devoted to preliminary environmental testing to establish the performance baseline for the TODS hardware. FY 1987 will be devoted primarily to design studies to nail down the final TODS hardware configurations and performance expectations. FY 1988 will be devoted to concept verification and build of the hardware. FY 1989 will conclude the build phase and begin initial flight/field testing of hardware.

C. (U) Project: 2810, Digital Mapping Charting and Geodesy Technology. This project was transferred from PE 63259F in response to Congressional recommendation to reduce R&D line items. The Cartographic Applications for Tactical and Strategic Systems (CATSS) program will develop data base structures which support multiple Air Force systems requirements for such applications as navigation, targeting, and weapons delivery. Applications algorithms will be develop to more efficiently manipulate/transform/exploit the data and develop techniques to assist users and developers to more accurately define their requirements. There will be two outputs. The first will be a single Air Force specification for its future digital cartographic data base needs. This will reduce the proliferation of system-unique data base requirements and permit significant portions of the Defense Mapping Agency's cartographic data production resources to shift into expanding the terrain coverage and away from the costly reformatting of existing data. For the Air Force,

this will enhance the operational effectiveness and flexibility of new systems being fielded; e.g., cruise missiles. The second product will be a set of computer software support tools for digital cartographic data. This development will produce algorithms to take the Defense Mapping Agency's generic data base output and transform it to the data structures needed for generic functional application and will produce techniques to compact the data to meet the limited data storage capabilities of operational systems. Delivery of these tools to weapons systems developers will eliminate the present practice of paying for depulicative contractor efforts on different programs to address functional applications. Additionally, it will allow developers to improve and verify their systems designs by using the actual Air Force data base during their experimental design phase. In FY 1986, the generic software data base definition and implementation was completed. The result of this effort was a specification standardizing Air Force requirements for digital cartographic data. This specification is input to the Defense Mapping Agency's planned FY 1987 master data base update. The data base structural definition phase was completed. Development of a sensitivity model for the evaluation of how changes to systems requirements affect the data base structures was also completed in FY 1986. In FY 1987, transformation and compaction software development will begin. The detailed design implementation and demonstrations are scheduled to start in FY 1987 and conclude in FY 1990. Interactive refinements of the detailed applications design with system developers will begin. The Air Force specification development for standardized digital cartographic data will be completed in FY 1987 and transitioned to the Defense Mapping Agency (DMA) to support their master data base update. Refinements to this specification will be an ongoing effort as operational users and system developers participate in the detailed applications design demonstrations starting in FY 1987. During FY 1988, detailed design implementation and demonstrations will continue. Operational users and weapon systems developers involvement during these demonstrations will be fed back into refining the consolidated Air Force requirements specification. Transformation and compaction software development will continue. During FY 1989, demonstrations of the compaction/coordinate transformation software development will continue and conclude in FY 1990.

D. (U) Project: 2478, Tactical Command, Control and Communications (C^3) Architecture. This project develops Tactical Air Force C^3 mission area studies in conjunction with Air Force theater tactical commands and in cooperation with the Tactical Air Force Interoperability Group. This project involves the development of road maps, task sequences, schedules, and cost estimates for the orderly and evolutionary improvement of the TACS. The FY 1986 task focused on completing Advanced Tactical Battle Management (ATBM) contracts specifying options for developing a more capable and survivable TACS for the 1990 and post-2000 time frame. In FY 1987, efforts will continue to refine an architecture for the future 21st Century TACS. In FY 1988, a three year effort will commence to define, develop and demonstrate a sensor netting capability to automatically fuse track data from multiple sensor sources in a stressed environment. This effort will lead to a sensor netting, full-scale development to support the Advanced Tactical Surveillance System under PE 27412F. In FY 1988 and FY 1989 study, efforts will also continue to refine TACS architecture. Potential development efforts stemming from Air Force Systems Commands FORECAST II study will be incorporated into TACS improvement plans.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63728F
DOD Mission Area: 551 - Electronic and Physical Sciences

Title: Advanced Computer Technology
Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		6,729	9,235	5,128	12,249	Continuing	N/A
2527	Software Life Cycle Tools	2,844	3,289	1,176	3,500	Continuing	N/A
2529	Computer Architecture Applications	438	976	847	1,474	Continuing	N/A
2530	Distributed System Reliability and Survivability	2,887	3,642	1,575	3,345	Continuing	N/A
2532	Knowledge-Based Systems	560	1,328	1,530	3,930	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Science and Technology program develops and demonstrates technologies to control cost, reduce risk, and increase efficiency and effectiveness of mission critical computers and software. The Department of Defense has experienced a dramatic escalation in costs for acquiring and supporting software for computers embedded in weapon systems. The increasing complexity of military systems coupled with the availability of smaller, more powerful computer hardware has promulgated the use of digital computers and resulted in an unprecedented demand for software. Development and support of software are labor intensive processes and their spiraling costs are a function of increased demand. In addition, the proliferation of computer systems in our weapon systems dictate that those systems be more reliable and survivable in the battlefield environment. This program also develops distributed processing and optical processing technology for improved system power, fault tolerance, reliability and survivability. In addition, this program is the Air Force's primary focus for the development of Artificial Intelligence (AI) technology and selected applications of AI to Air Force systems.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	7,309	10,491	10,637	N/A	Continuing	N/A

EXPLANATION: (U) Reduction in FY 1987 due to Congressional reduction. Reduction in FY 1988 due to OSD adjustment in response to FY 1987 funds being appropriated but not authorized.

4. (U) OTHER APPROPRIATION FUNDS: Not applicable.

5. (U) RELATED ACTIVITIES: This program complements the three components of the Department of Defense (DOD) sponsored software technology initiative: DOD Common Programming Language - Ada (PE 63226F), Software Technology for Adaptable, Reliable Systems (STARS) (PE 63756D), and DOD Software Engineering Institute (SEI) (PE 63752F). The Ada program establishes and controls the Ada language and related DOD technical management standards. The STARS program exploits Ada software engineering opportunities and industry expertise to advance software development technology. The SEI program transitions state-of-the-art software engineering technology to DOD programs. Whereas the DOD software technology initiative's primary focus is Ada-related, the Advanced Computer Technology program focuses on next generation technologies in software (e.g., knowledge-based systems, artificial intelligence, logic programming, symbolic evaluation) and hardware (e.g., distributed system, optical processing). The combination of the DOD's software technology initiative and the Air Force's Advanced Computer Technology program provide a balanced overall program. This program receives advances in technology developed in the Command, Control, and Communication program (PE 62702F) and transitions technology to the Computer Resource Management Technology program (64740F).

6. (U) WORK PERFORMED BY: The Rome Air Development Center, Griffiss AFB, NY, has management responsibility for this program. The five primary contractors are: Martin Marietta, Denver, CO (Project 2527); General Research Corporation, Santa Barbara, CA (Project 2527); Stanford Research Institute, Menlo Park, CA (Project 2530); Carnegie-Mellon University, Pittsburgh, PA (Project 2530); and Honeywell, Minneapolis, MN (Project 2532). There are an additional twelve contractors performing work for this program with a total dollar value of $2.7 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 2527, Software Life Cycle Tools. This project develops software engineering technology to reduce the cost and improve the quality of mission critical software-intensive weapon systems. Efforts under this project address all phases of the software life cycle from requirements definition and specification through design, code, test, integration, and post deployment support. The primary emphasis is to develop programming and management aids to increase the quality of software while reducing the cost. In FY 1986, implementation of a software engineering environment (an integrated set of methods, procedures, and supporting computer programs that support the entire software life cycle) was initiated. In addition, implementation of a rapid prototyping system was also started. The rapid prototyping system will enable operational users to quickly construct workable software models of selected critical system functions such as man-machine interfaces, data base designs/data flows, and communication parameters. This will allow us to identify user requirement/developer interpretation errors in the software design phase where it costs 36 times less to fix the problem than in the maintenance phase where these errors are historically discovered. Another major thrust of this project is to develop techniques to quantitatively measure the quality of software. These techniques are currently being automated and will allow software quality to be specified as a deliverable item to the government during weapon system development. This work will continue in FY 1987. In FY 1988, system enhancements will be initiated. Additionally in FY 1988, the software engineering environment will be tailored to support the

development of Command, Control, Communications and Intelligence (C^3I) software. This environment will be completed in FY 1989 and the rapid prototyping system will be completed in FY 1988. Also in FY 1988, the design for a software quality and productivity laboratory will be started. This laboratory will allow for the study of the multitude of factors which affect the software development process. In FY 1989, the development of preliminary capabilities required for this laboratory will be initiated. Projects to be initiated in FY 1989 will define concurrent processing strategies and develop automatic programming techniques. The objective of the strategy definition work is to ensure that the full capabilities of concurrent processing are used by the programmer. The automatic programming work will greatly reduce the amount of time and labor involved with development of reusable software modules.

B. (U) Project: 2529, Computer Architecture Applications. This project evaluates commercial and Department of Defense developed computer architectures to determine their applicability and efficiency to Air Force C^3I applications. Current emphasis is in evaluating a 32-bit architecture and developing an optical processor. Future needs in the C^3I arena will require tremendous computing power in a limited physical space. A promising solution is the 32-bit architectures which have more power than the current 16-bit systems. In FY 1986, evaluation of an Army-developed 32-bit system continued. Starting in FY 1987, this architecture will be extended to incorporate a real-time response capability, an Ada cross-compiler, computer security features for stand-alone and distributed systems, and autonomous fault-tolerant operation. A method to effectively evaluate 32-bit architectures will be developed and transitioned to system program offices. Optical processing is another promising new technology. Its inherent speed, hardness, and low power consumption make it ideal for many future systems. In FY 1987, this project will begin developing a general purpose digital optical computer. During FY 1988, design specifications for the central processing unit, memory, and interconnections of an optical computer will be developed. Also, a demonstration model of critical electro-optical computer elements will be built and demonstrated. In FY 1989 additional extensions to the architecture will be developed and final evaluation of the system will be completed by FY 1991. Also in FY 1989, detailed design specifications of a hybrid optical computer will be completed. These specifications will be used as a basis for the evolutionary development of a next-generation digital "all-optical" computer. In FY 1988, an effort to develop a secure, distributed operating system architecture for software development will begin. Initial demonstrations of this system will occur in FY 1990. This system will meet the multilevel security and distributed processing needs of a modern software engineering effort. The system will be completed by FY 1991.

C. (U) Project: 2530, Distributed System Reliability and Survivability. This project develops techniques and tools for distributed data processing systems. The primary goal is to develop a processing environment that provides survivability through reconfiguration in the event of lost components or nodes. The ultimate goal will be to demonstrate survivability of a distributed system configuration application to both strategic and tactical C^3I systems. New starts and continuation efforts in FY 1986 emphasized Distributed Operating Systems (DOS) development and resource control techniques, survivability and reconstitution techniques, and prototype demonstration. These requirements will become more critical as the requirement for spaceborne command and control systems, operating in conjunction with ground and airborne systems, is addressed. During FY 1987 the DOS will be enhanced by the addition of improved resource control mechanisms which will improve performance and survivability. Prototype demonstrations will continue in the Rome Air Development Center Distributed Systems Evaluation Environment as a vehicle to integrate the products of

multiple development efforts. In FY 1988 the application of Artificial Intelligence (AI) techniques to support decentralized resource management will be investigated. Development will begin on tools to support the design, implementation, test, and evaluation of distributed systems in FY 1989. These tools will use many of the capabilities developed under the software engineering program in project 2527, but will be extended into the distributed system environment. The work under this project will culminate in a real-time distributed system demonstration in FY 1990. This system will be the basis on which battle management/Command, Control, Communications and Intelligence systems of the future will be based. Still to be addressed in the outyears is multilevel security and the development of AI to dynamically restructure the network after the loss of a base/node.

D. (U) Project: 2532, Knowledge-Based Systems. This project focuses on the development of computer-based systems, called knowledge-based systems (KBS), able to solve reasoning problems which would otherwise require a human expert. Performing as a surrogate for a human expert, a KBS is comprised of the following components: a rule set containing reasoning expertise, an inference process which uses the rules to solve problems posed by users, and an interface for communicating with users. This project has two major thrusts. The first is to provide software tools and techniques that can be used to develop and evaluate knowledge-based systems. The second thrust is the application of technology to provide cost-effective capabilities to develop and acquire knowledge-based systems for application such as weapon system maintenance, logistic planning, tactical and strategic decision support systems, resource allocation, situation assessment and intelligence analysis, and to exploit knowledge-based methods to effect an order of magnitude improvement in software development and support activities. In FY 1986, a system was developed to support rapid implementation of intelligent man-machine interfaces for knowledge-based application. Advanced development continued on a dedicated AI programming system that will provide integrated support for logic and function programming capabilities. In FY 1987, advanced development of the Knowledge-Based Software Assistant (KBSA) program will be initiated. The KBSA will apply existing AI technology to conventional software development activities to assist in improving programmer productivity and software reliability and maintainability. In FY 1988 efforts will be initiated to develop a program to expand current AI technology to perform adaptive planning of Strategic Air Command operations for the strategic trans/post-attack environments. Also in FY 1988, KBSA will be continued with emphasis in developing individual modules which address each phase of the software life cycle: system requirements software requirements, preliminary and detailed design, code and debug, unit test and integration, formal testing, and operations and maintenance. This work will continue in FY 1989 with emphasis shifting to the integration of these modules into a single system. The advantage gained by this system is the shared data base. In this way, time and money savings are realized through a more efficient, accurate, and informed decision-making process. In the outyears, AI will be integrated into the system.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63743F — Title: Electronic Combat Technology
DOD Mission Area: 551 - Electronic & Physical Sciences (ATD) — Budget Activity: 2 - Advanced Techology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		12,976*	37,653	41,288	47,600	Continuing	N/A
691X	Electronic Warfare Technology	0 *	11,800	12,815	14,418	Continuing	N/A
2432	Warning and Power Management Systems Technology	0 *	7,100	8,163	10,097	Continuing	N/A
2754	C^3 Countermeasures Technology	0 *	2,100	2,700	2,500	Continuing	N/A
2222	Advanced Electro-Optical Countermeasures	3,573	8,153	7,140	7,345	Continuing	N/A
431G	Electro-Optical Warfare	9,403	8,500	10,470	13,240	Continuing	N/A

*PE 63718F transferred to this PE in 1987

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides advanced development in the area of electronic warfare where an expanded technology base is needed to solve critical penetration aid problems for all classes of infrared, electro-optical, and laser threats. The program includes advanced Electronic Warfare (EW) transmitters, receivers, advanced power management, and command, control, and communication countermeasures. This program also provides for component, technique and subsystems development leading to the reduction of acquisition and life cycle cost of electronic warfare equipment and systems. Note that this PE now incorporates PE 63718F, Electronic Warfare Technology. This program element was previously titled Electro-Optical Warfare.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

Program Element: 63743F
DOD Mission Area: 531-Electronic and Physical Sciences (ATD)

Title: Electronic Combat Technology
Budget Activity: 2 - Advanced Technology Development

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
RDT&E	39,455	53,363	50,469	N/A	Continuing	N/A

(U) EXPLANATION: Reduction in FY 1988 is the result of a general reduction in science and technology programs. The FY 1987 reduction was a result of Congressional action.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. RELATED ACTIVITIES: This program now incorporates, under one PE, the work covered in prior years by PE 63718F, Electronic Warfare Technology, and PE 63743F, Electro-Optical Warfare. The work is closely coordinated with related Army and Navy efforts through Joint Reviews conducted by the Joint Director of Laboratories/Technical Panel for Electronic Warfare and is coupled with the engineering development community of the three services through the Joint Technical Coordinating Group for Aircraft Survivability and Electronic Warfare. Exploratory development technology is phased into this program from PE 62204F, Aerospace Avionics and from related Army and Navy programs. Technology Transition Plans are prepared for major efforts undertaken within this PE addressing technology transfer to full-scale development programs within the Air Force. Completed electronic warfare (EW) efforts are transitioned into the engineering development programs: PE 64220F, EW Counter Response; PE 64710F, Reconnaissance Equipment; PE 64724F, Tactical Command and Control (C^3) and Communications Countermeasures; PE 64738F, Protective Systems; PE 64737F, Airborne Self-Protection Jammer; and PE 64739F, Tactical Protective Systems. Joint Air Force/Navy efforts include the Integratd Electronic Warfare System, Infrared Chaff, and the Advanced Infrared Countermeasures Jammer programs.

6. (U) WORK PERFORMED BY: The Air Force Avionics Laboratory, Wright-Patterson AFB, OH, manages the program. Testing is performed primarily at the Air Force Armament Division, Eglin AFB, FL, and the Tonopah Test Range at Nellis AFB, NV, although other DOD test facilities are sometimes used. The major contractors are: Westinghouse, Baltimore, MD (2222, 2432 & 691X); General Electric Corp, Binghampton, NY (2222); TRW, San Diego, CA (2432); Raytheon, Goleta, CA (691X & 24320); and Northrop, Rolling Meadows, IL (691X & 2432). There are approximately twenty-four other contractors having contracts with a face value of $28.641 million. Also, the Rome Air Development Center, Griffiss AFB, NY, manages two tasks in Project 2754, C^3 Countermeasures.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR KY 1989:

A. Project: 2754, C^3 Countermeasures Technology: This project consolidates Command, Control and Communication Countermeasures (C^3CM) efforts previously conducted in Project 691X and new efforts designed to develop and de strate counters to enemy C^3 systems. Major thrusts include: airborne jamming and deception techniques; drone-borne and expendable C^3CM; and analysis, simulator and evaluation support. In order to accomplish their assigned missions and improve aircraft survivability, the Tactical Air Force (TAF), Strategic Air Command (SAC) and Electronic Security Command (ESC) require a combined air and ground capability to degrade selected enemy communication links, integrate

this information into the signals intelligence network, and display enemy ground controlled intercepts and prevent effective use of Surface-to-Air Missiles (SAM) and Anti-aircraft Artillery defenses. This is a technology base program which supports TAF General Operational Requirement 301-78, ESC SONs 1-80 and 3-80, and SAC Required Operational Capabilties 23-69. In FY 1985 the

This development was transitioned to engineering development in FY 1986 with the recommendation that at least the improved compressive receiver be considered for technology insertion. The radar jammer module of the Mini-Drone Jammer was mounted on a helicopter and tested against an instrumented acquisition radar on the Eglin range as well as in Green Flag exercise at the Nellis ranges. Data was gathered on proximity effect jamming. The Mini-Drone Jammer is targeted against

Development of a Command, Control and Communications Countermeasures (C^3CM) transmitter module was initiated that will markedly

Software design and Preliminary Design Review have been completed. In FY 1986,

The FY 1986 program also completed the efforts in development of C^3CM transmitte modules,

The other major FY 1986 efforts were the initiation of the

jammer development and free flight of Mini-Drone Jammer, Wideband

C^3CM, spectrally pure (power sharing) transmitter

The planned program for FY 1987 and into FY 1988 will continue the Strategic Link Jammer, low band HF C^3CM, Wideband

C^3CM, spectrally pure transmitter, and risk reduction development of

The only new start will be development of a C^3 Sensor Signal Fusion Project to supplement the Strategic Link Jammer. In FY 1989, the program continues C^3CM Advanced Mini-Drone Payloads development initiated in FY 1988, completes Wideband C^3CM design and laboratory dmonstration, completes Low Band C^3CM development and test efforts, completes the Matchwell Sensor Data Fusion effort, and initiates brassboard development and field test of a Wideband C^3CM system. Cost estimates are Category III, Budgetary.

B. Project 2222, Advanced Electro-Optical Countermeasures: The primary purpose of this project is to develop technology for detecting and countering

directed threats to aircraft. Virtually all tactical Soviet surface-to-air weapons employ

either as their primary modes of

In addition to such threats, the

is also addressed from a countermeasures standpoint. Under this project the overall systems technology is developed, as well as the necessary supporting component technology. The approaches considered under this project address

of threats of concern, as well as threat detection and countermeasures approaches. Testing of the ALQ-179 Electro-Optical Countermeasures (EOCM) Pod was conducted and completed in FY 1986. Continued development of the CORONET PRINCE prototype will occur in FY 1987 intending to design, develop, fabricate, assemble, and flight test an EOCM system program. Continuing improvements are underway for

The Countermeasures Against Fighters program was initiated to develop a concept for

system. Studies were continued to define the effects of

In FY 1988, an EOCM system capable of meeting the year 2000 threat will be addressed. Technology suitable for the Integrated Electronic Warfare

System will be addressed. Advanced development of will continue. Countermeasures Against Fighters program will also be continued into FY 1988 and FY 1989. Cost estimates are Category III, Budgetary.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 691X, Electronic Warfare Technology

A. (U) Project Description: This project provides advanced development of new countermeasures techniques and hardware for both existing and new radio frequency electronic warfare systems. The project includes the following areas: (1) a supporting simulation effort that guides the allocation of funding through the evaluation of new concepts and techniques; (2) systems components and techniques needed to jam enemy radar; (3) on-board jamming systems, component and techniques needed to jam enemy radar; (4) off-board or expendable systems to confuse enemy radars and dilute enemy defenses; (5) electronic collection systems to inform the field commander of changes in the electronic environment; (6) the development of standardization and low cost reliable and maintainable components and systems to enable the Department of Defense to better afford the increasing amount and sophistication of electronic countermeasures equipment required on modern aircraft; and (7) development of advanced stand-off jammer technology that will lead to greatly reduced on-board countermeasures requirements. The enemy air defense network is characterized by both airborne and land based radar and communication systems that locate, monitor, guide and control offensive and defensive elements. The enemy continues to improve these elements against our forces and our operational countermeasures. This requires a strong technology base to provide demonstrated counters to these improvements and avoid technological surprises by new enemy threat systems. This project is a technology base effort which supports Tactical Air Command Statement of Operational Needs (SONs) 315-73, 301-78, and 304-80; Strategic Air Command SONs 23-69, 13-73, 6-81; and Military Airlift Command SONs 7-81, 8-81, and 9-81.

B. (U) Program Accomplishments and Future Efforts:

(1) FY 1986 Accomplishments: The issue is being investigated through digital engagement simulations that define needed Electronic Warfare (EW) capabilities such as warning, missile avoidance, and countermeasures. A primary application will be toward the Advanced Tactical Fighter, wherein a special investigation is examining the warning system output needed to avoid missile attack through maneuvers. The first phase of the program was completed.

Investigation of special jamming array technology neared completion. Also, program that will flight test new experimental chaff units was continued. The Cross Trak and Sabre Cross systems were flight tested against

These tests evaluated performance against In addition, testing evaluated The 30 month technology risk reduction effort continued for a capability that will adapt the for airborne operation and application. This will serve as a precursor to a specialized capability. An 18 month effort was started to develop a that will provide a with applicability to the

Program Element: 63743F
DOD Mission Area: 551-Electronic and Physical Sciences (ATD)

Title: Electronic Combat Technology
Budget Activity: 2 - Advanced Technology Development

EF-111A. A 24-month Reliability and Maintainability effort, entitled Pathfinder, was started to analyze equipment and component type failures and technical weaknesses. A 40-month Power Supply Reliability Improvement program was started to upgrade the Standard Radio Frequency Chain amplifier system.

(2) FY 1987 Program: Complete tri-service warning, jamming and chaff efforts, AF/Navy high power transmitter, technology, advanced radar signal high speed recognizer effort, Electronic Countermeasures (ECM) simulation and evaluation. Initiate new for use against tasking radars. Continue solid state jammers for stand-off and self-protection, development of a lower cost, high reliability, development, Continue EW hardware developments, update New starts include high power microwaves, terrain reflectivity measurements, reliability and maintainability EW study, countermeasures, Traveling Wave Tube improvement efforts, brassboard, Military Airlift Command (MAC) EW suite development, and initial design of a towed RF decoy for tactical aircraft.

(3) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Continue efforts including Electronic Countermeasures simulation and modeling, of antennas and EW subsystems, technology, improved chaff/expendables, active Radio Frequency (RF) expandable, improved capability for stand-off aircraft (EF-111A), development of a lower cost, highly reliable jammer, countermeasure risk reduction, terrain reflectivity measurements, reliability and maintainability EW study, Traveling Wave Tube (TWT) improvement effort, high effective radiated power jammers, MAC EW, and development. Further, feasibility, studies and flight demonstration of a towed decoy will continue. Cost estimates are Category III, Budgetary.

(4) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Continue R&M efforts to include standard EW architectures to be included within/parallel airframe design programs specifically focusing on modular, VHSIC based design criteria. Continue EW Techniques Analysis and Penetration Aids Evaluation to analyze and evaluate promising EW technologies prior to development. Continue New Chaff Technology, Multi-Spectral Observable Reduction Demonstrations and Dilution Drone developments to augment off-board countrmeasures solutions for strategic and tactical penetration. Continue development of ALQ-99 Band 7/8 solid state transmitters and /ECM subsystems. Continue fabrication, flight test and evaluation of an EW Suite for MAC aircraft and towed RF decoy. Cost estimates are Category III.

(5) (U) Program to Completion: This a continuing program.

C. (U) Major Milestones:

Milestones	Dates
(1) (U) Solid State Amplifier Critical Design Review	October 1986
(2) (U) Advanced System Eval Flight Test	August 1987
(3) (U) Solid State Amplifier Ground Test	April 1988

Program Element: 63743F | Title: Electronic Combat Technology
DOD Mission Area: 351-Electronic and Physical Sciences (ATD) | Budget Activity: 2 - Advanced Technology Development

Milestones	Dates
(4) (U) High Power Technology Flight Test	May 1988
(5) (U) High Power Microwave Concept Demonstration	August 1989

9. (U) **PROJECT OVER $10 MILLION IN FY 1988 AND/OR 1989:**

(U) **Project: 2432, Warning and Power Management Systems Technology**

A. **Project Description:** This project develops integrated systems technologies to cope with the projected threat environments for strategic and tactical aircraft. Although the primary emphasis is on electronic warfare, issues relating to integration with offensive and mission avionics and the total air vehicle are also addressed. This project includes the following areas: (1) advanced multi-spectral power management systems to develop and evaluate optimum system configuration, (2) high speed, flexible jamming signal generators, (3) threat receiver technologies that are smaller, can handle dense signal environments and are able to detect (4) high speed signal processors and data bases that can sort through data and determine optimum jamming responses, (5) receive and transmit antennas which can provide precise threat direction and unambiguous warning to aircrews, and (6) shared function concepts including for Electronic Countermeasures (ECM) and radar functions and multiple function infrared systems capable of

The enemy air defense network relies on integrated multi-spectral systems to search, acquire, target and guide missiles and antiaircraft fire. Because of this proliferation of different multi-spectral systems in large numbers and over a large portion of the electromagnetic spectrum, sophisticated systems are required to analyze the threat environment and either warn aircrew of potential threats or initiate an automatic jamming response. This project is a technology base effort. User requirements are documented in Tactical Air Forces Statements of Operational Need 304-80, 315-73, and Strategic Air Command Required Operational Capability 3-79.

B. (U) **Program Accomplishments and Future Efforts:**

(1) **FY 1986 Accomplishments:** The ECM Power Management "Hot Bench" was developed using the VHSIC Processor as the core element, and the High Density Environment Simulator was completed and delivered to the Dynamic Electromagnetic Environment Simulator (DEES) for testing. The frequency synthesizer reliability improvement program was continued as was the receiver development higher order language (Ada) software development efforts, and integrated electronic warfare subsystem risk reduction developments.

(2) **FY 1987 Program:** In-house hot-bench development will concentrate on the integration with available receivers and processors along with the ECM techniques generator from the Advanced Power Management System program. This will be integrated with the DEES for continuing in-house power management activities. Support will continue for the Common Signal Processor, addressing a variety of Electronic Warfare (EW) processing needs. Plans will be formulated for an advanced EW receiver-processor front end for possible inclusion in future Radar Warning Receiver upgrade programs. An investigation into the specific value, potential, and shortcomings of the Ada higher order programming language will proceed. Radio Frequency investigations and situational assessment algorithm, will be initiated, as will similar investigations in the Electro-Optical/Infrared areas.

(3) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Continue efforts including integrated "Hot Bench" experimentation, initiate development of an advanced radar receiver and signal processor, angle-of-arrival power management concepts, and developments. Continue multi-spectral /development, Very High Speed Integrated Circuit signal processors and analog optical signal processors. Complete higher order language software analysis. Continue investigations of integrated multiple function shared asset systems addressing combined offensive and defensive functions. Cost estimate Category III.

(4) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The program will continue applying Advanced EW processing techniques to counter 1990 threats work will continue to develop an advanced signal processor and multi-spectral receiver. VHSIC insertion for EW application will be demonstrated further a multi-sensor fusion demonstration will be conducted to examine problems in fusing data. This demo is designed to enhance a pilot's situational assessment of his battle environment. Specifically, Continue special antenna feed network and applications of antenna technology to demonstrate precision angle-of-arrival measurements. Continue adaptive Higher Order Language EW Software demonstration Tactical Situational Assessment and Response Strategy and Advanced Integrated Processing technologies where real time artificial intelligence schemes will be demonstrated in an EW expert system concept.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones:

Milestones	Dates
(1) (U) Frequency Synthesizer Lab Demonstration	April 1988
(2) (U) Situational Assessment Design Review	April 1988
(3) (U) ECM Power Management Hot Bench Test	May 1988
(4) (U) Multi-Sensor Fusion Demonstration	August 1989

10. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 431G, Electro-Optical Warfare

A. Project Description: This project demonstrates advanced development countermeasures against enemy air defense guidance systems which operate in the infrared (IR) spectrum. Examples of such systems are IR heat seeking missiles which home in on aircraft jet engines and aircraft. Improvements in these systems and development of new weapons using parts of the infrared spectrum require continuing development to gain and maintain an advantage over the threat. In the past, enemy air defense systems operated only in the communications and radar frequencies However, Efforts in this project include a supporting simulation and analysis effort that guides the allocation of funding through the evaluation of new concepts and techniques to prevent or delay detection of U.S. Air Force aircraft, receiver systems for

aircraft to warn crewmembers and activate countermeasures and decoys, and jammers to counter enemy air defense weapons. This project is a science and technology effort which supports Tactical Air Forces Statements of Operational Need (SONs) 20-68, 312-75, 304-80, 312-80, Strategic Air Command Required Operational Capability 4-76, and Military Airlift Command SONs 7-81, 8-81, and 9-81.

B. (U) Program Accomplishments and Future Efforts:

(1) FY 1986 Accomplishments: The flare programs was flight tested, as well as an concept suitable for low performance aircraft. Work continued on the Advanced Laser Warning System Program designed to technology. Work continued on the advanced to counter systems and The Advanced Aerodynam Flare program was completed refining the performance of an aerodynamic flare. The goal was to control to defeat the The Passive Optical Expendable program for developing a The Joint AF/Navy Laser Ranging Countermeasures (LARC) program developing

(2) FY 1987 Program: The planned program for FY 1987 includes analysis and effectiveness of countermeasures techniques, simulations using the Dynamic Infrared Missiles Evaluator facility, development of sources, and countermeasures against The Silent Attack Warning System (SAWS) will be initiated to develop and demonstrate a Scheduled for completion are development and testing of the Aerodynamic Flare, investigation of for warning receivers, and the direction finding technology effort. New starts for FY 1987 are planned for an advanced on-board jammer using sources in a closed loop system to counter advanced warning receiver, and demonstration of a system that provides missile warning for attack from the Finally, the High Performance IR Decoy program will begin to develop technology to

(3) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The efforts in expendables, specifically the Advanced Aerodynamic Flare, will address the increasing flare rejection capability of IR seeker threats. The following programs will address improvements in detecting and locating missile and aircraft threats. The Silent Attack Warning System addresses Future warning systems are supported by a current program to develop monolithic detector arrays to replace scanning infrared technology. Also applicable to threat warning is continued effort to demonstrate an IR window having optimum transmission properties with a minimal drag penalty. Development of modulated laser sources for use with a future laser jammer will also be pursued.

(4) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The will be reviewed for possible transition to the manned bomber fleet. A SAWS demonstration and ground test program will begin as well as a field test of the Warning System. Cost estimates are Category III, Budgetary.

(5) (U) Program to Completion: This is a continuing program.

C. (U) MAJOR MILESTONES:

Milestones	Dates
(1) (U) Silent Attack Warning System Design Review	July 1987
(2) Warning Critical Design Review	December 1987
(3) (U) High Performance (IR) Decoy	August 1988
(4) (U) Advanced IR Countermeasures Design Review	September 1989
(5) (U) Silent Attack Warning System Field Test	November 1989
(6) Warning Field Test	November 1989

11. (U) COOPERATIVE AGREEMENTS: Not Applicable

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63751F — Title: Training Systems Technology
DOD Mission Area: 552 - Environmental and Life Sciences (ATD) — Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		0	0	276	471	Continuing*	N/A
* 3057	Intelligent Computer-Assisted Training	0	0	276	471	5,380	6,127

* This is not a new start Program Element. Efforts documented for FY 1987 and prior years under Program Element 63751F have been consolidated with Program Element 63227F, Personnel, Training, and Simulation Technology to meet Congressional direction to reduce the number of Program Elements.

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This is not a new start Program Element. This Science and Technology Program funds advanced development of cost-effective advanced technical training systems to increase the efficiency and productivity of Air Force personnel. Rapidly changing technology and the increasing complexity of Air Force systems places increasing demands upon the training community for both formal school and on-the-job training. Intelligent computer-assisted training devices will help reduce training workload, increase effectiveness of instructional simulations, and increase training performance, without the need for increased manpower for training. This methodology will be especially amenable to high-flow career fields, high-technology environments, and the complex training requirements anticipated for space related technologies.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E (Project 3057 Only)	0	0	250	N/A	5,852	6,127

EXPLANATION: (U) The FY 1987 Descriptive Summary included funding for Projects 2362, 2557, 3056, as well as project 3057. Except for Project 3057, all efforts formerly described under Program Element 63751F have been consolidated in Program Element 63227F, Personnel, Training, and Simulation Technology.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: Related Air Force program elements are 61102F, Defense Research Sciences; 62205F, Personnel, Training and Simulation; 63227F, Personnel, Training, and Simulation Technology; and 63106F, Logistics Systems Technology. Related Navy and Army program elements are 62757N, Human Factors and Simulation Technology; 63701N, Human Factors Engineering Development; 63720N, Education and Training; 63743A, Education and Training. The Air Force

Human Resources Laboratory closely monitors all significant research and development being conducted by other Department of Defense, National Aeronautics and Space Administration, and industrial organizations. Exchange of proposed statements of work for contractual efforts, wide dissemination of technical reports, and attendance at symposia and meetings ensure that work conducted within this program element benefits from and does not duplicate work conducted by the other Service laboratories. Close coordination within the Air Force user community is also accomplished by annual research and development coordination meetings between the Laboratories, the Aeronautical Systems Division, and the Major Commands.

6. (U) WORK PERFORMED BY: The program is managed by the Air Force Human Resources Laboratory, Brooks AFB, TX, through the Training Systems Division (AFHRL/ID), Brooks AFB, TX. Major contractors are: Not Applicable.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3057, Intelligent Computer-Assisted Training (ICAT).

A. (U) Project Description: New and increasingly complex weapon systems and rapidly changing technology are vastly increasing Air Force training requirements while training resources remain relatively fixed. This requires the Air Force to rely more heavily upon on-the-job training and more efficient methods of training, such as computer-based training. This is especially true in areas that require high levels of training, such as space shuttle launch and control, space vehicle tracking, and space operations. This FY 1988 new start project will develop systems specifications for Intelligent Computer-Assisted Training (ICAT) in various training applications where payoff promises to be high and identify technology demonstrations for these applications. ICAT differs from current conventional computer-assisted instruction in that the "intelligent" system makes judgments about what the student knows and how well he/she is progressing, tests those judgments, and provides appropriate instruction or assistance--automatically, without the need for human instructor intervention. In effect, the training system acts as a tutor, not just a training delivery device. When completed, this project will provide field demonstrations of intelligent computer-assisted training applications and guidelines for expanded use. This is not a new start program element. Due to administrative error, this project was not transferred to consolidated Program Element 63227F, Personnel, Training, and Simulation Technology. All projects formerly included in Program Element 63751F are now documented in Program Element 63227F.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Not Applicable.

(2) (U) FY 1987 Program: Not Applicable.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: This moderately high-risk, five-year program is designed to capitalize on the advances in intelligent computer-aided instruction and personal computer engineering. It will focus on cost effective, efficient delivery of training. Phase I, beginning in FY 1988,

will consist of a comprehensive review and evaluation of state-of-the-art intelligent computer-assisted training technology and the computer hardware required for training development and delivery.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Phase II, beginning in FY 1989, will consist of initial software design and development of specifications for the prototype testbed. The design will include development of interactive design tools for course developers, and modeling to allow for adaptation of training delivery for multiple instructional environments, differences in student ability, and differences in instructional presentation, and automated expertise capturing systems.

(5) (U) Program to Completion: In FY 1990, full scale development of the intelligent computer-assisted training (ICAT) testbed will begin, with demonstrations and evaluations beginning in FY 1991. The ICAT testbed will be demonstrated on selected high technology space-related specialties in cooperation with the Air Force Undergraduate Space Training school at Lowry AFB, Colorado. Evaluations will include assessments of training and cost effectiveness for various ICAT applications and guidelines for expanded use. Outyear efforts will also include downloading from specialized artificial intelligence processing machines to standard Air Force computer systems.

C. (U) Major Milestones:

Milestones	Dates
(1) (U) Complete Software/Hardware Design	September 1989
(2) (U) Complete Development of Testbed	September 1990
(3) (U) Begin Field Demonstration and Evaluations	October 1990
(4) (U) Final Report and Recommendations	September 1992

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63752F
DOD Mission Area: 551 - Electronic and Physical Sciences

Title: DOD Software Engineering Institute (SEI)
Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	10,663	14,197	18,929	18,794	Continuing	N/A
3200	DOD Software Engineering Institute (SEI)	10,663	14,197	18,929	18,794	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Science and Technology program supports the creation and operation of the Department of Defense (DOD) Software Engineering Institute (SEI) to accelerate transition of evolving software technology into use in development and support of computer-intensive weapon systems. As weapon systems have become more dependent on computers, the problems encountered in developing and supporting reliable, cost-effective software for those weapon systems' computers have grown to very large proportions. The DOD has implemented three complementary software thrusts to supplement and focus current service programs that are developing technology to solve these problems. Of the three, the SEI is the only program focusing on the transition of emerging software technology common to all military services and Defense agencies. In addition to technology problems, manpower shortages plague the software development community. There exist two possible solutions to these problems; each will improve the quality of the technology in use for building critical software systems. First, provide productivity aids for the software developers to reduce the manpower required to develop software, or second, increase the number of software engineers. The SEI is pursuing both of these solutions and will transition technology to achieve each of them. Need for the SEI was documented in the reports of the DOD Joint Task Force for Software Technology of Adaptable, Reliable Systems, March 1983, and by the blue-ribbon Industry/Academia SEI Study Panel administered by the Institute for Defense Analysis for the Office of the Deputy Under Secretary of Defense Research and Advanced Technology in November 1983.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	11,443	9,541	14,328	N/A	Continuing	N/A

EXPLANATION (U) The increase in FY 1987 reflects Congressional action. The increase in FY 1988 reflects Air Force budget evaluations which restored the program budget to amounts necessary to meet plans baselined at contract award in December 1985.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: 63752F
DOD Mission Area: 551 - Electronic and Physical Sciences

Title: DOD Software Engineering Institute (SEI)
Budget Activity: 2 - Advanced Technology Development

5. (U) RELATED ACTIVITIES: The Software Technology for Adaptable, Reliable Systems (STARS) program, PE 63756D, uses the SEI as its major mechanism for software technology transition. The DOD Common Programming Language (Ada) program, PE 63226F, is also coupled with the activities of the SEI. Interface with these programs is through the STARS and Ada joint program offices located within the Office of the Secretary of Defense. In addition, the Software Engineering Institute (SEI) transitions software technology developed in academia, in the private research community, and the computer technology programs in all the Services.

6. (U) WORK PERFORMED BY: Carnegie Mellon University manages the SEI as a Federally Funded Research and Development Center. Electronic Systems Division, Hanscom AFB, MA, is the administrative agency for the SEI contract. General policy and program guidance is provided by a Joint Advisory Committee consisting of the Joint Logistics Commanders and executives of the Office of Secretary of Defense and other Defense agencies. The program office supports representatives from the Army, Navy, and Air Force on-site at the SEI.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3200, DOD Software Engineering Institute (SEI)

A. (U) Project Description: The SEI accelerates the transition of computer software technology into weapon systems. Emphasis is on identification of user requirements and current development efforts, evaluation and integration of prototype software tools and methods, and of life-cycle automated software development and support environments, and use of integrated environment approaches during the development and life-cycle support of computer-intensive weapon systems. The SEI also provides technical advice, consultation, and direct support to the military services and Defense agencies. The SEI evaluates, upgrades, and evolves prototype software tools to production quality, and integrates these tools into production and support software environments for use in developing and supporting software for mission critical systems.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: The functionality of the Army/Navy Ada language system was studied and generic criteria were developed for evaluating Ada software development environments. Bootstrap operations of a limited Ada environment became the first activity of the software showcase. Technology assessment reports were delivered. These covered user interfaces, tool interfaces, data base support required for software environments, and software technology for distributed systems. Software data rights issues were researched in depth and results were presented to the Defense Science Board task force on software. Key conclusions were also presented to the Deputy Assistant Secretary of Defense for Procurement. Over 200 technical experts from industry and government have attended workshops and a three day forum sponsored by the SEI on concepts and technology available for use in software factories. Affiliate programs have been established with over 40 major corporations and with ten universities. These

include GE, IBM and CDC. On-site personnel have been provided by GE and two Navy laboratories. The permanent SEI staff has grown to 85, and the temporary facility computing environment is fully operational. Finally, joint development of a curriculum for a Master of Science in software engineering was begun with assistance from AT&T, IBM, Wang Labs, and SEI academic affiliates.

(2) (U) FY 1987 Program: The seven major technical thrusts approved in the SEI Five Year Plan are under way. These address future software engineering systems, technology assessment, software reuse, Ada transition, and dissemination of software engineering know-how, through direct participation in weapons systems programs, through the SEI software showcase, through elimination of obstacles to necessary technology transition, and through software engineering education. In addition, efforts to organize and staff the SEI will continue with the major goals of starting operations in the permanent facility before FY 1988 with a technical staff of over 150. To automate and systematize future software engineering for DOD, the SEI will identify and define building block prototypes of technology which improve software development and maintenance. These will include a prototype distributed operating system, a model data base of persistent data objects, and various models of tool interfaces. Technology assessments of software engineering methods will be obtained from pilot applications which stress impacts on development and performance of real-time systems, on requirements analysis, and on integrated documentation. Existing reuse technology will be identified, and analytical workshops will be conducted. Ada transition will be increased through Pilot Ada Capabilities Transition projects for mission-critical systems. These will recode existing functions, and gather benchmark development and performance data. To disseminate state-of-the-art know-how, the SEI is establishing a showcase of advanced methods, tools and ideas for software engineering. The information network for this showcase will be implemented and a prototype software change and configuration control system will be designed. Through this showcase, a software development capability for open and integrated programming in Ada will be demonstrated starting in FY 1988. To eliminate barriers to technology transition, the SEI will examine the regulations and the technical needs which apply to protecting proprietary intellectual property, while also permitting unimpeded and competitive life-cycle support of government software. Finally, to expand the number and productivity of our national resource of software engineers, the SEI will produce the initial increment of a forty module software engineering curriculum and sponsor its first annual conference on software engineering education.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: SEI technical thrusts will emphasize demonstrations and validations of models, prototypes, and concepts identified in FY 1987. Operations are planned to be under way in the permanent SEI facility, and a major emphasis will be to reach a critical mass of 182 technical staff members including 72 resident affiliates, and to establish the schedule of annual SEI activities for future years. In automating and systematizing future software engineering for DOD, the SEI will evaluate the useability of prototype distributed operating systems as common frameworks for the advanced computer security, user interfaces, and high speed data bases of future software engineering systems. The tool integration capabilities of typical interface definition languages will be established and the capacities of persistent data objects for knowledge-based engineering will be demonstrated. Applications demonstrations will be tailored for developers of mission critical systems. Milestone reports will be prepared for continuing technology assessments. These will emphasize interface standardization, portability, Ada, reuse, interoperability, and costs of use as well as attainment of real-time performance, early and

testable identification of requirements, and the degree of user friendliness and self-documentation available. Selected reusable software and reuse methods will be demonstrated for specified mission critical systems applications. Ada transition projects will build upon FY 1987 experimental designs for evaluation of Ada software engineering capabilities, impacts on the software life cycle, and suitability for design of large real-time systems. The SEI software showcase will begin periodic demonstrations in its permanent facility to disseminate state-of-the-art techniques for distributed software design, configuration control, software maintenance verification and installation, and software engineering design automation. Efforts to eliminate barriers to necessary transition of technology will examine implications of work completed in FY 1987, and will explore solutions for organizational, administrative, and economic impediments to the use of state-of-the-art technology in DOD software developments. Two faculty development workshops will be held to examine software engineering curriculum materials developed jointly with academic affiliates. The second increment of curriculum modules will be developed and distributed to academic affiliates for evaluation, and a second annual conference on software engineering education will be sponsored. Cost estimates for this work are budgetary, but are derived almost completely from cost of operating at the required level of member-technical-staff (MTS) support to achieve baseline objectives.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The SEI will initiate major efforts towards engineering prototype mechanisms to actively control the information required by the software development process. Data structures and tools which automatically check and enforce data consistency are needed for use in a knowledge-based expert systems approach to improving software engineering. Technology transition exercises will engage users and developers in defining and evolving software engineering information integration mechanisms which also enable effective automation of a reusable specification, design and programming process. This reusability approach is one of the keys to establishing a component and architecture based discipline for software engineering. Other new and major emphases in FY 1989 will include examination of software engineering tools which can learn from their own experience and assessment of mechanisms for embedding heuristics and judgment functions into design and development tools. Software development tools for non-Von Neumann computer architectures and semantics based methods for specification development and validation, as well as specialized means to integrate new software engineering tools into existing development environments, will also be assessed and demonstrated. The SEI affiliates projects with government offices will continue to be strongly supported as a means for technology transition. Also continued development of curriculum modules will enable broad based review of the evolving standard Master of Science in Software Engineering. Curriculum modules will be packaged for limited presentations and to highlight specialized topics. The SEI showcase will provide support for language-independent components which can be shared within a variety of development environments. The showcase will also conduct demonstrations of a distributed system monitoring methodology and of the use of remote distributed bit map technology for improved graphics based software engineering processes. Workshops, conferences, seminars, and specialized direct support projects will continue and deliveries of software factory design notes and technology assessment reports will also be provided.

(5) (U) Program to Completion: This is a continuing program.

Program Element: 63752F
DOD Mission Area: 551 - Electronic and Physical Sciences

Title: DOD Software Engineering Institute (SEI)
Budget Activity: 2 - Advanced Technology Development

C. (U) Major Milestones:

Milestones			Dates
(1)	(U)	Contract Awarded	December 1984
(2)	(U)	Initial Software Engineering Master of Science Curriculum Released	September 1986
(3)	(U)	Software Engineering Capability Assessment Criteria to be Released	June 1987
(4)	(U)	Initial Capability - Embedded Software Systems Tested	June 1987
(5)	(U)	Initial Capability - Software Engineering Info Net (SEI-Net)	September 1987
(6)	(U)	Fully Operational Permanent Facility	September 1987
(7)	(U)	Full Capability - SEI Net	May 1988
(8)	(U)	Total Technical Staff Strength - 182	September 1988
(9)	(U)	Persistent Data Base Control Demo	June 1989

(U) Explanation of Milestone Changes

(U) Milestones have been restructured and are now consistent with the SEI five year program plan and with technical plans baselined at contract award.

9. (U) COOPERATIVE AGREEMENTS: The Software Engineering Institute (SEI) interacts with government, industry, and academic organizations to execute its mission of technology transition. Key cooperative agreements exist with such government organizations as Army Materiel Command, Space and Naval Warfare Command, Rome Air Development Center, and Air Force Systems Command. Cooperative agreements with industry include such major corporations as Boeing, Hughes, IBM, Magnavox, RCA, Raytheon, Rockwell, Shell, Sperry, Tektronix, and United Technologies. Cooperative agreements with academic institutions include Arizona State University, Columbia University, University of Pennsylvania, Seattle University, University of Washington, Wayne State University, and Wichita State University. There are now 7 resident affiliate government and industry personnel, and over 12 affiliated academic personnel have participated in software engineering curriculum development. As of September 1986, the SEI had 85 industry affiliation agreements, and 24 academic affiliation agreements. The SEI is a party to two international agreements. One agreement, between the Australian Ministry of Defense (MOD) and USAF, places an Australian software engineer at the SEI for a one year residency. The cost is borne by the Australian MOD. The second international agreement is an academic affiliation agreement between the SEI and Queens University, Ontario, Canada. This agreement provides for the participation of Queens University in the development of software engineering curriculum modules. No funds transfers are involved in these agreements.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63789F
DOD Mission Area: 551 - Electronic & Physical Science (ATD)

Title: Tactical Command, Control & Communications (C^3) Advanced Development
Budget Activity: 2 - Advanced Technology Development

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	*FY 1986 Actual	*FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		37,308	18,647	42,809	47,696	Continuing	N/A
2314	Tactical Air Surveillance	10,708	9,256	10,300	13,095	Continuing	N/A
2315	Automated Tactical Intelligence	1,776	Transferred to PE 63260				
2317	Tactical Information Distribution	718	815	2,100	3,700	Continuing	N/A
2321	Tactical Battle Information Management	1,161	1,985	6,800	5,388	Continuing	N/A
2333**	Tactical Radar Electronic Counter-Countermeasures (ECCM)	3,070	2,732	2,830	4,872	Continuing	N/A
2334**	Airborne Radar Electronic Counter-Countermeasures	3,893	Transferred to PE 63203F				
2335**	Communication & Navigation Electronic Counter-Countermeasures	2,609	3,260	4,931	4,363	Continuing	N/A
2345***	Airborne Imagery Transmission	5,896	Transferred to PE 63253F				
2347**	Optical Counter-Countermeasures	1,975	Transferred to PE 63203F				
2478	Tactical C^3 Architecture	2,838	Transferred to PE 63726F				
2746***	Low Probability of Intercept Communications	1,744	Transferred to PE 63253F				
2747***	Communication Vulnerability Analysis	684	549	598	328	Continuing	N/A
2748***	Advanced High Frequency Technology	186	0	200	250	Continuing	N/A
2749***	Hardened Antenna Technology	50	50	50	0	Continuing	N/A
3192	Tactical Optical Disk System (TODS)	0	Transferred to PE 63726				
3433****	Advanced Communication Technology	0	0	15,000	15,700	Continuing	N/A

Program Element: 63789F Title: Tactical Command, Control & Communications (C^3)
DOD Mission Area: 551 - Electronic & Physical Sciences (ATD) Advanced Development
Budget Activity: 2 - Advanced Technology Development

* Prior years reflect the 1988 Science and Technology restructure for comparability purposes only.
** Transferred from PE 63750F
*** Transferred from PE 63727F
**** New Project

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Modern tactical battle scenarios are complex and dynamic. Extreme pressure will be on surveillance, command and control, and communications elements to maximize combat effectiveness. These combat tools must survive and operate together for the battle commander to effectively control his forces. New technologies for these tools must also grow together, and be directed towards an integrated tactical control system which will overcome the threat and support current force doctrine. Accordingly, this science and technology program develops and demonstrates surveillance, command, control, and communications technology to support air superiority and close air support missions in tactical operations. Specific vulnerabilities and counter-countermeasures are evaluated and developed. Includes conceptual system design, system engineering and fabrication of advanced development models for test and demonstration.

3. (U) COMPARISON WITH FY 1987 Descriptive Summary: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
RDT&E	15,858	22,963	25,582	N/A	Continuing	N/A

EXPLANATION: (U) FY 1986 difference due to reprogramming to higher priority programs, Congressional reductions, and program element consolidation transfers. FY 1987 difference due to Congressional reduction and program element consolidation transfers. FY 1988 difference due to reprogramming to higher priority programs, overall Air Force Total Obligation Authority reduction, addition of new project 3433, and program element consolidation.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: This program is a key part of the Air Force effort to improve surveillance, command, control, and communications capabilities. Related technology development programs are 62792F, Command, Control, and Communications; 63742F, Combat Identification Technology; 63726F, Fiber-Optic Development; 63260F, Intelligence Advanced Development; 63203F, Reconnaissance Sensors/Processing Technology; 64710F, Reconnaissance Equipment; and 64748A, Army Modular Integrated Communication/Navigation System. Technologies developed by this program are being coordinated with and will directly feed 27411F, Overseas Air Weapons Control Systems; 27412F, Tactical Air Control System; 27423F, Advanced Communication Systems; and 27417F, Airborne Warning and Control System.

6. (U) WORK PERFORMED BY: This program is managed by Air Force Systems Command, Andrews AFB MD, with project effort

PE: 637

being conducted by the Electronic Systems Division, Hanscom AFB, MA, and Rome Air Development Center, Griffiss AFB, NY. Current contracts are for solid state transmit/receive module design, Advanced Tactical Surveillance Radar cost performance trade-off studies, an advanced tactical radar transmitter, reassessment of antenna sidelobe performance requirements, demonstration of automatic adaptive radar control, low cost phase shifters, bistatic Identification Friend or Foe, modification of Tactical Analog/Digital Information Link - A for the Advanced Tracking System, and a Tactical Expert Mission Planner. Magnavox Data Systems, Falls Church, VA is the main contractor for communications vulnerability analysis (2747). ITT Avionics Division, Nutley, NJ is working the high frequency technology efforts (2748). The Advanced Airborne Surveillance Radar (AASR) efforts have been conducted by the Boeing Corp., Seattle, WA; Westinghouse, Baltimore, MD; and Grumman Aerospace, Bethpage, NY (2333). Decoy studies for current and follow-on tactical radars have been performed by GRC, Santa Barbara, CA and General Electric, Utica, NY (2333). The Advanced Mainbeam Electronic Counter-Countermeasures (ECCM) Technology Radar (AMETR) is being developed by International Telephone and Telegraph Gilfillan, Van Nuys, CA (2333). The Low Cost 20 Megahertz Data Link is being developed by Hughes Aircraft, Los Angeles, CA (2335) . MITRE Incorporated, Bedford, MA, provides support for Projects 2314, 2321, 2747 and 2748. Lincoln Laboratory, Bedford, MA, is conducting development efforts in Project 3433.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 2317, Tactical Information Distribution. This project transitions Advanced Communications Technology to Tactical Command and Control Systems (TACS). These technologies are required to accommodate the extensive communications requirements of future TACS. In FY 1986, ongoing efforts continued to define an Automated Decentralized Information Exchange architecture. In FY 1986, a study to define performance parameters for local networks concluded. For FY 1987 three new efforts will be undertaken: a two year program to define communications requirements for integrating a Ground Attack Control Center capability into a Mission Control Element; a four year program to demonstrate Integrated Radar Burst Communications (IRC), and a two year program to develop an architecture for tactical packet communication. In FY 1988, the automated decentralized information exchange definition phase will transition to a 3 year demonstration program. Sensor netting developments will be undertaken in support of the Advanced Tactical Surveillance System development. Developments will commence for the netting of voice and databases among command and control centers by netting current and planned radars into a single, multilevel-secure, multimedia communications resource. In FY 1989, a four year program will commence to demonstrate a secure, multimedia, anti-jam, programmable modem/controller.

B. (U) Project: 2321, Tactical Battle Information Management. This project will improve decision making procedures through the use of computer based decision aids, decision making tools,and Artificial Intelligence (AI) techniques to support command and control operations in high stress and time critical environments. It allows improved operations with inexperienced operators through AI based decision aids. This technology based effort is directed at deficiencies spelled out in the Tactical Air Force Integrated Information System Master Plan. The Tactical Expert Mission Planner (TEMPLAR) applies AI techniques to the Tactical Air Force resource allocation process using automated data processing based decision aids to facilitate generation of an Air Tasking Order. The implementation phase of TEMPLAR continued in FY 1986. In FY 1987, a five year program will commence to develop and demonstrate a series of

Program Element: 63789F Title: Tactical Command, Control & Communications (C^3)
DOD Mission Area: 551 - Electronic & Physical Sciences (ATD) Advanced Development
Budget Activity: 2 - Advanced Technology Development

automated command management decision aids. These tools have the potential for significantly reducing TACS manning requirements. In FY 1988, the Tactical Expert Mission Planner program will be completed and efforts will continue to develop tactical and command management decision aids. The Rome Air Development Center (RADC) command and control technology laboratory will evolve to provide a facility to support the rapid transition of tactical battle management capabilities from the laboratory to user testbeds. A TACS data repository (TACS data dictionary) will be designed and implemented to support follow-on data base design efforts. In FY 1989, work will continue on the development, integration and evaluation of tactical decision aids. Tactical command, control, communications and intelligence technology demonstrations with promising potential to meet user requirements will transitioned to user test sites for evaluation. The Rome Air Development Center (RADC) Mobile Lab will support additional user site evaluation and experience with prototype systems. Activities will be initiated to demonstrate the functional distribution of Tactical Air Control System (TACS) activities for the 21st century TACS.

C. Project: 2333, Tactical Radar Electronic Counter-Countermeasures (ECCM). This project develops ECCM technology applicable to search and surveillance radars such as TPS-43, APY-1/APY-2 (E-3 AWACS), and generic future radars.

Tasks include demonstration of: advanced radar mainbeam technology to counter noise jamming and interference through adaptive nulling; the Advanced Airborne Surveillance Radar (AASR) as an advanced ECCM follow-on to AWACS; and anti-radiation missile (ARM) decoy technologies to negate enemy destructive countermeasures. FY 1986: Completed Advanced mainbeam ECCM Technology Radar (AMETR) integration and checkout and began system software development and adaptive spatial and polarization nulling experiments. Completed delivery of 150 conformal array transmit/receive modules (CAM), subarray integration, and antenna pattern testing. Fabricated and tested the mainbeam ARM decoy antenna. FY 1987: Complete AMETR nulling experiment and software development. Develop the Advanced Tactical Surveillence Radar (ATSR) ARM decoy advanced development model specification. Begin development of a 1000 CAM array for flight demonstration of AASR conformal array technology FY 1988: Complete preliminary and critical design reviews for the AASR conformal array. Validate results of the AMETR nulling experiments. Complete preliminary and critical design reviews for the ATSR ARM decoy. FY 1989: Continue AMETR effort. Continue AASR technology ground demonstration. Begin procurement of AASR components for flight demonstration. Begin smart jammer study. Continue validation of AMETR nulling experiments. Complete ATSR decoy components in preparation for decoy integration tests.

D. Project: 2335, Communication and Navigation Electronic Counter-Countermeasures (ECCM). This project develops and demonstrates adaptive digital data/voice communications and navigation ECCM technologies to protect tactical command control, and communications assets from enemy disruption and exploitation.

Primary emphasis is on airborne and mobile ground based tactical command and control elements and advanced weapon data link guidance. FY 1986: Completed Low Cost 20 Megahertz Data Link demonstration. Began Jam Resistant Communication (JARECO) development which reduces jamming/intercept vulnerability through advanced signal processing techniques. Began Multi-media Resource Controller (MRC) development using advanced ECCM technologies to provide a survivable, adaptive, tactical air control system. FY 1987: Complete the extremely high frequency (EHF) flight demonstration. Continue JARECO and MRC work. FY 1988: Take delivery of MRC.

Complete Jam Resistant Communications (JARECO) hardware installation. Begin evaluation of JARECO enhanced communication systems. Begin Extremely High Frequency (EHF) application study. Initiate modular enhancement program for the Improve Weapons Data Link. Begin virtual source simulation. FY 1989: Complete JARECO demonstration. Complete EHF application study. Complete Multi-media Resource Controller demonstration. Begin antijam/low probability of intercept transceiver effort. Complete virtual source simulation and begin demonstration.

E. (U) Project: 2747, Communication Vulnerability Analysis (CVA). As a result of a deployed Soviet Command, Control and Communication (C^3) countermeasure threat, the Air Force is investing heavily in Electronic Countermeasure systems. At the same time, Soviet electronic countermeasures technology continues to evolve. The Air Force needs to consolidate expertise and develop a comprehensive methodology for vulnerabilities analysis and testing of communication systems, including large, netted C^3 systems. This project was created to address this need. The CVA project will consolidate the technical efforts and expertise in communications vulnerability analysis and will develop, test, and evaluate a comprehensive methodology and special test equipment for assessing the vulnerability of developmental C^3 technology, equipment and systems to detection, deception, exploitation and jamming. This program will give the Air Force an evaluation tool that can be applied to advanced communications systems during their development, thereby reducing costly "after the fact" system modifications and greatly increasing the degree of confidence of decision makers in approving systems for further development and production. FY 1986 accomplishments in this project were as follows: completion of integration of threat data and environments; completion of definition of CVA test bed; continuation of acquisition of special test equipment; beginning integration of methodologies, simulations, and test equipment into a comprehensive CVA facility. The FY 1987 planned program will continue the integration of methodologies, simulations and test equipment into the CVA facility. The FY 1988 planned program will complete the initial CVA facility integration and provide support for vulnerability assessment effort in other programs. The FY 1989 planned program continues the vulnerability assessment of selected command and control systems.

F. Project: 2748, Advanced High Frequency Technology. Traditionally, the High Frequency (HF) radio has been used as a primary means of long-range communications by military forces. However, in past years, its use has been deemphasized because of its susceptibility to jamming, nuclear effects and natural ionospheric disturbances. Coupled with this has been the increased emphasis on the use of satellite systems to provide worldwide communications. [

the Air Force requires reliable, alternative communication systems to satellite systems. Both Military Airlift Command (MAC) and Strategic Air Command (SAC) have stated requirements for this improved capability (SAC Required Operational Capability 5-77, MAC General Operational Requirement 3-77). [

] Advanced capability Electronic Counter-Countermeasures modules will be developed that may be applied to future HF radio enhancements. In FY 1986 this project continued development/fabrication of narrowband HF modules, focusing on voice source encoding over narrowband HF channel adaptive channel equalization, adaptive signal processing, and frequency hopping and continued planning for future

testing. The 1987 planned program for this project includes: completing fabrication of narrowband High Frequency (HF) modules; initiating development/fabrication of a frequency hopping coupler; and continuing test planning. The FY 1988 planned program continues development/fabrication of a frequency hopping coupler and continued test planning. The FY 1989 planned program completes development/fabrication of a frequency hopping coupler and begins testing.

G. Project: 2749, Hardened Antenna Technology. HF radio has been used as a contingency commuications mode for many years.

] In FY 1987, this project will begin to develop the theoretical characterization of]properties, physical properties and theory of operation. The FY 1988, planned program completes the theoretical antenna systems to validate the theory through collection of empirical data. The vulnerability to man-made and natural disasters will be explored and characterized.

8. (U) PROJECTS OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2314, Tactical Air Surveillance.

A. (U) Project Description: This program develops advanced radar technology supporting the Advanced Tactical Surveillance System (ATSS). The goal of the ATSS is to provide continuous and reliable air surveillance and current depiction of the friendly and hostile airspace situation. It includes (1) detection of air activity (position, altitude heading, identity and flight size); (2) continuous tracking of all detected objects; (3) passive detection of Electronic Countermeasures and Identification Friend or Foe emitters; (4) identification and classification of targets (cooperative and non-cooperative); and (5) sensor track correlation. This project evaluates advanced technology such as Solid State Transmit/Receive (T/R) module conceptual design and system engineering, and demonstrates equipment and/or procedures that address users' stated requirements for an ATSS. These efforts are required to develop affordable radar technologies supporting the FY93 planned start of the ATSS Advanced Tactical Surveillance Radar program.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: A significant portion of the cost to produce an Advanced Tactical Surveillance Radar (ATSR) will be the cost for the phased array antenna. A major effort in this project is to develop technologies for affordable array components. In support of this effort, programs were continued to compete phased array antenna technologies based on ferrite phased shifters and travelling wave tubes against riskier solid state antenna technologies. In addition, radar system performance specifications need to be developed which lead to an affordable full scale development program. In support of this effort the Phase I ATSR Cost/Performance Trade-off Studies were completed with a total of 16 possible candidates to be considered for Phase II. Finally, the Advanced Tactical Surveillance System is required to track and identify targets with high credibility. Target identif[illegible]

classification testing of radar images started using the Rome Air Development Center signal processing laboratory hardware to assess the capability for a C-Band radar to do the identification function.

(2) (U) FY 1987 Program: The FY 1987 program involves continuation of seven high technology areas previously initiated for the Advanced Tactical Surveillance Radar (ATSR): (1) detailed radar system trade-off studies, (2) development and test of solid state transmit/ receive modules, (3) development of a technology base to reduce cost and increase efficiency of phase shifters for phased array radars, (4) reassessment of antenna sidelobe performance requirements via simulation/field tests, (5) demonstration of automatic, adaptive radar control in noise/clutter/electronic countermeasures environment, (6) reassessment of tracking computation requirements, and (7) development and test of a highly stable brassboard transmitter with variable duty cycle. Work will begin on a noncooperative target recognition capability. The data collection and evaluation for identification/classification will continue. Effort will be initiated to develop and test passive jammer location equipment.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The remaining high technology efforts of the restructured Advanced Tactical Surveillance Radar (ATSR) program will continue. Development of a consolidated ATSR Type A Specification will be initiated combining results of previous cost/performance trade-off and other technology programs. This consolidated specification will form the basis of the full scale development program. The Solid State Transmit/Receive Module program will continue. Work will continue on the Passive Jammer Location equipment, and non-cooperative target identification. Work will continue toward development of a passive surveillance capability for the Advanced Tactical Surveillance System (ATSS) with initiation of Bistatic Identify Friend or Foe (IFF) Test/Evaluation. Cost estimates for this advanced development project are planning in nature (Category IV) based on program office and contract analysis of similar efforts or extrapolation of current actual costs. These cost estimates were completed in July 1984 and August 1985.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The Type A Specification for the ATSR will be completed. The Non-Cooperative identification efforts will be completed. The Solid State Radar demonstration will continue. Work will continue toward development of a passive surveillance capability for the ATSS. Work will continue on Bistatic IFF Test/Evaluation and Passive Jammer Location equipment. Cost estimates for this advanced development project are planning in nature (Category IV) based on program office and contractor analysis of similar efforts or extrapolation of current actual costs that are relevant to those expected by FY 1989. These cost estimates were completed in July 1984 and August 1985.

(5) (U) Program to Completion: Support Electronic Systems Division in preparation of documents facilitating full scale development of the Advanced Tactical Surveillance Radar. Efforts will continue to promote improvements to solid state antenna component technology and C-Band Radar Mainbeam Nulling. In addition, continued investigation of various target identification technologies will also be performed. This is a continuing program to provide Advanced Tactical Command, Control and Communications Development.

C. (U) Major Milestones:

Milestones	Dates
(1) (U) Detailed Cost/Performance Study	February 1987
(2) (U) Automatic Adaptive Radar Control	June 1988
(3) (U) Solid-State Transmit/Receive Module Demonstration	June 1988
(4) (U) Type A Specification for ATSR	December 1988

9. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3433, Advanced Communications Technology

A. (U) Project Description: This project will demonstrate internetting of data from satellites across mission areas. It develops a Lasercomm Intersatellite Transmission Experiment (LITE) package, which is a lightweight, low powered, high data rate communication package that incorporates semiconductor laser heterodyne optical communication technology.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: In FY 1986, at Lincoln Laboratory, flight quality, solid state gallium arsenide diodes were procured and life testing began, working brassboards of transmitter and electronic modules were developed and work began on an opto-mechanical subsystem. Requirements and preliminary design of the LITE package were completed.

(2) (U) FY 1987 Program: In FY 1987, detail design of the LITE package will be completed. Subassembly and subsystem testing at National Aeronautics and Space Administration Lewis Research Center will certify spacecraft interfaces.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: During FY 1988, fabrication and test of the prototype LITE flight model for this effort will be completed. A link between low earth orbit platforms and a geosynchronous satellite will be developed. Cost estimates for this advanced development project are planning in nature (Category IV) based on program office and contractor analysis of similar efforts or extrapolation of current actual costs that are relevant to expected FY 1988 tasks. Cost estimates were completed in April 1986.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The LITE flight package will be assembled and tested. Cost estimates for this advanced development project are planning in nature (Category IV) based on program office and contractor analysis of similar efforts or extrapolation of current actual costs that are relevant to expected FY 1989 tasks. Cost estimates were completed in April 1986.

(5) (U) Program to Completion: Advanced Development culminates in FY 1990 with the launch of the National Aeronautics and Space Administration Advanced Communication Technology Satellite.

C. (U) Major Milestones:

Milestones	Dates
(U) Satellite Launch	December 1990

10. (U) Cooperative Agreements: Not Applicable

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63311F
DOD Mission Area: 111 - Land-Based Strike

Title: Advanced Strategic Missile Systems (ASMS)
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		147,910	145,000	134,162	151,979	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Air Force program develops, applies, and proves ballistic missile technology by conducting advanced development for operational intercontinental ballistic missile (ICBM) system applications. Early development work is pursued to gain confidence in engineering feasibility of new technologies and concepts to insure their readiness for full scale development and to provide timely solutions for identified ICBM mission changes and evolving threats. ASMS also conducts tri-Service intercontinental range flight testing of exploratory reentry vehicles and penetration aid systems. The combination of Soviet throwweight advantages, capability to field advanced anti-ballistic missile defenses, continuing efforts upgrading offensive effectiveness (e.g. better missile accuracy), and increased pace in projecting force, all point to a need for the United States to be prepared to upgrade the missile force with offsetting advanced weapons.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	159,756	176,915	184,515	N/A	Continuing	N/A

(U) In FY 1986, $9.025 million was deleted as result of the Gramm-Rudmann reduction. Congress reduced FY 1987 by $27.916 million without prejudice. Revised Department of Defense FY 1988-92 fiscal guidance and subsequent ASMS program restructuring reduced the FY 1988 funding by $50.353 million.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: ASMS efforts are coordinated with the activities of the Army's Strategic Defense Command; the Navy's Strategic Systems Program Office; the Defense Advanced Research Projects Agency; the Defense Nuclear Agency; the Department of Energy, Military Applications; the Strategic Defense Initiative Office; Government laboratories and testing facilities; and other agencies associated with ballistic missiles, reentry and penetration technologies, and assessments of basing modes for high survivability and endurance. Efforts are coordinated with the Minuteman program (PE 11213F) and the ICBM Modernization (Peacekeeper, Small ICBM) program (PE 64312F) for development of advanced reentry vehicles, penetration aids systems, advanced missile guidance, and demonstration launches. Tri-Service and intra-Air Force coordination is achieved through annual program reviews and working level exchanges. Effective coordination and avoidance of duplication with the ICBM Modernization and Minuteman programs are achieved through joint management and collocated program offices within the Ballistic Missile Office.

PF: [illegible]

Program Element: 63311F
DOD Mission Area: 111 - Land-Based Strike

Title: Advanced Strategic Missile Systems (ASMS)
Budget Activity: 3 - Strategic Programs

6. (U) WORK PERFORMED BY: The responsible Air Force agency is the Ballistic Missile Office, Norton Air Force Base, CA. Major contractors include: McDonnell Douglas Astronautics, Huntington Beach, CA (maneuvering reentry vehicle technology, defense suppression vehicle); TRACOR Aerospace, Austin, TX (penetration aids, deployment system); AVCO Corporation, Wilmington, MA (advanced nosetip testing, defense suppression vehicle, optical penetration aids); Acurex Corporation, Mountain View, CA (radar and optical penetration aids), and the Boeing Company, Seattle, WA (launch services). The ASMS program currently maintains contracts with 36 contractors and makes extensive use of Government laboratories. Total definitized value of current contracts is $354.3 million, with some periods of performance extending through calendar year 1990.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 63311F, Advanced Strategic Missile Systems

A. (U) Project Description: This program is a continuing activity that conducts advanced development of key ballistic missile, reentry, and basing systems/subsystems to correct deficiencies and maintain effectiveness of our ICBM force. This development process accomplishes system definition and requirements analyses, preprototype fabrication and both ground and flight testing, all paced to achieve baselined milestones identified and coordinated by the using command (Strategic Air Command) and the implementing command (Air Force Systems Command). The program directly address four validated and two draft Strategic Air Command Statements of Operational Need.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: The Peacekeeper and Minuteman III penetration systems decoy candidates (active and passive) successfully completed the last test in a series of three flight tests. Peacekeeper penetration aids deployment systems (PADS) were fabricated and one was flown with both active and passive decoys in late FY 1986. Hardware for testing components of an accurate evader MaRV in three FY 1987 flight tests were fabricated. Contracts were initiated to explore concepts (replica decoys and pyrotechnic devices) to defeat optical ballistic missile defense systems. Two contractors continued with competing concept feasibility designs for the defense suppression vehicle. Fabrication of advanced nosetips candidates continued to support future Severe Environment Nosetip Test flight tests. Minuteman I flight test support was provided for an ASMS penetration aid flight.

(2) (U) FY 1987 Program: FY 1987 funds will complete the advanced development of penetration aids for Peacekeeper and Minuteman III as a counter to Moscow defense upgrades in progress and as a hedge against deployment of defenses beyond Moscow. PADS, decoys, and advanced chaff, will again be flown on two Peacekeeper flights in FY 1987. Miniaturization and hardening of the active decoy will be initiated. Three flight tests will demonstrate components of an accurate evader MaRV including new material for the nosetip, new radar antenna windows for the terminal fix sensor (TFS) system, and an alternate control system concept. TFS candidates will complete their first series of

aircraft captive flight tests. The evader maneuvering reentry vehicle (MaRV) readiness program will commence with emphasis on radiation-hardened parts and advanced inertial measurement unit (IMU) developments. Competing defense suppression vehicle concepts will continue with a preliminary design review for flight requirements and will terminate with a concept downselect. A preliminary design will be done in FY 1987 for an earth penetrator vehicle capable of attacking hard, deeply buried, time-urgent targets. Ground testing of selected optical countermeasure concepts will be initiated in FY 1987. Two Severe Environment Nosetip Test (SENT) flights will be conducted to test the performance of candidate advanced nosetips (passive, transpiration-cooled, and gasjet cooled) in the stringent environments involving high pressures and heat transition rates associated with depressed trajectories. ASMS will provide flight test support for four Minuteman I flight tests (two SENT tests, MaRV materials technology, MaRV antenna window), two Minuteman III flight tests (Small ICBM advanced guidance systems), and three sounding rocket tests (Army optical data).

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The FY 1988 funds will be used to continue advanced development and ground testing of the active decoy and to initiate a parallel flight test program. The accurate evader MaRV will complete the technology demonstration stage in FY 1988. Test data from FY 1987 ballistic missile and aircraft captive flight tests will be reduced, analyzed, and results incorporated in the final vehicle design. One terminal fix system concept will be selected for further refinement. Also in FY 1988, the evader MaRV readiness program will continue radiation hardened parts and advanced IMU development and begin designs of technology flight test vehicles for tests in FY 1990-91. For the optical countermeasures program, ground testing and optical data collection will continue this year. ASMS will support three sounding rocket flight tests for the Minuteman III Advanced Penetration Aids Program. Costs for ASMS advanced development tasks were estimated as of November 1986, based on negotiated contractor prices and Government experience on similar advanced development programs. Ongoing ASMS program costs are category III, Budgetary, and planned efforts are category IV, Planning.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The FY 1989 funds will be used to complete the ground test phase of the optical countermeasures program and to initiate the flight test phase. Detailed design of flight test and operational vehicles will be started. For the active decoy, miniaturization and hardening of electronic components and flight test planning will be continued. Completion of an operational design is scheduled for FY 1990. An evader MaRV will continue in design and two technology demonstrator vehicles will be fabricated for flight tests in FY 1990 and FY 1991. The second series of aircraft captive carry tests will be conducted on TFS concepts. ASMS will provide flight test support for seven Minuteman flight tests (three Army ballistic missile defense target tests, two Minuteman III penetration aids tests, one pyrotechnics and one evader replica penetration aids flight test). Costs for advanced development tasks were estimated as of November 1986 based on negotiated contract prices and Government experience on similar advanced development programs. Ongoing ASMS program costs are category III, Budgetary, and planned efforts are category IV, Planning.

(5) (U) Program to Completion: Follow-on Minuteman I flight tests will be conducted in the outyears for upgrades to the Peacekeeper and Minuteman III penetration system options (e.g., advanced radar/optical penetration aids and decoys, maneuvering vehicles) to meet the evolving Soviet defensive threats. Two technology flight tests for the evader MaRV readiness program will take place in FY 1990 and FY 1991. Additional optical countermeasure flight tests will take place in FY 1990-92. Also, the active decoy will complete ground testing in FY 1990 and commence flig

testing. Feasibility studies will continue on selected concepts that could provide Intercontinental Ballistic Missile assets the capability to attack relocatable targets and buried targets.

C. (U) Major Milestones: Not applicable since decisions have not been made to pursue engineering development, production, or deployment of these systems. Advanced development milestones are described above.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63364F Title: Short Range Attack Missile II (SRAM II)
DOD Mission Area: 113 - Airborne Strike Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		29,682	66,528	220,386	231,589	516,018	1,064,203

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Strategic Air Command requires an improved Short Range Attack Missile (SRAM) to improve the operational flexibility of our penetrating bombers by providing a single weapon to strike defended, hard and relocatable targets without having to directly overfly targets. SRAM II is a supersonic, air-to-ground nuclear weapon that severely stresses the defensive threat. The combination of supersonic speed, low observability and variable flight profile makes SRAM II highly survivable in terminal defense zones. SRAM II significantly compounds enemy defense requirements and prevents optimization of defenses against low altitude subsonic targets. The required performance improvements relative to SRAM-A are attainable with existing technology. It is not the intent of this program to stress technology to its limits, but rather to build a state-of-the-art SRAM II using available technology.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	34,108	164,702	250,403	N/A	Continuing	N/A
Missile Procurement	0	0	2,022	N/A	Continuing	N/A

EXPLANATION: (U)

- FY 1986; Gramm/Rudman reduction and reprogrammings for other higher priority projects.
- FY 1987; Congressional reduction and reprogramming for other higher priority projects.
- FY 1988 reduction reflects contractor values rather than government parametric estimates.
- Additional to completion and total estimated cost reflect current program estimates.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

Missile Procurement:						
Funds	0	0	0	0	1,414,800	1,414,800
Quantities	0	0	0	0	1633	1633

5. (U) RELATED ACTIVITIES: SRAM II will be developed for internal carriage on the B-1B (PE 64226F). Activity will be conducted to integrate SRAM II on the multipurpose launcher. Funds are programmed in the B-1B program element to procure the hardware modifications to support SRAM II carriage. The SRAM II program element contains the RDT&E funds to develop the hardware modifications.

6. (U) WORK PERFORMED BY: Boeing Aerospace Company, Seattle, WA, and McDonnell Douglas Astronautics, St Louis, MO, have responded to our request for proposals. Boeing Aerospace was announced as the winner of the competition. Boeing Military Airplane Co, Wichita, KS, Boeing Military Airplane Co, Seattle, WA, and Rockwell International, El Sagundo, CA, will integrate SRAM II on the B-1B aircraft. The SRAM II program will be directed by Air Force Systems Command's Aeronautical Systems Division, Strategic System Program Office, Wright-Patterson AFB, OH.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: PE 63364F, Short Range Attack Missile II

A. (U) Project Description: The current SRAM is showing signs that it may be rapidly approaching the limits of its service life. Furthermore, the remaining SRAM inventory is steadily declining and is inadequate to support our penetrating bombers. It is prudent that we begin to actively develop a replacement for SRAM. SRAM II will address the concerns we have with SRAM including the need for performance improvements that will insure that our future bombers are weaponized with a high performance air-to-surface weapon that can defeat projected terminal defenses. An operational concept based on years of experience with SRAM is incorporated into the acquisition strategy which uses existing technologies in order to minimize risk and shorten the acquisition cycle.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: The system definition studies were completed in March. These studies included rocket motor firings, survivability tests and tests with the proposed inertial platforms. These system definition studies allow full assessment of system performance, cost, schedule, productivity, and supportability before beginning full scale development. Source selection started in July.

(2) (U) FY 1987 Program: A contract will be signed for full scale development. Both the missile system contractor and aircraft integration contractor will begin design and development of critical components. For the missile contractor, these components are airframe, rocket motor and tail assembly. The contractor will begin piece part design of the inertial guidance system, the missile computer and flight control software. The contractor will begin aircraft and missile integration work with the carrier aircraft contractor. The aircraft integration contractor will begin hardware and software development for modifications to the rotary launcher and the launcher avionics equipment. Both contractors will begin planning activities for the ground and flight test programs.

Program Element: 63364F
DOD Mission Area: 113 - Airborne Strike

Title: Short Range Attack Missile II (SRAM II)
Budget Activity: 3 - Strategic Programs

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Full scale development (FSD) activities will continue. Design of the missile and the aircraft interface will be completed. Once the missile and aircraft interfaces have been defined full scale integration testing will begin. Component testing and analysis of all missile systems and subsystems will continue. Fabrication of the flight test missiles will begin upon successful completion of the second engineering design review. Prototype rocket motor firing will continue to refine the selected design. Approximately 45 missiles will be procured with research, development, test and evaluation (RDT&E) funds. Plans for flight testing will be finalized. Cost data is based on a parametric estimate with analogies from the existing SRAM. The estimate category is III - G. Cost estimates assume that competitive proposals were obtained for FSD and the first two years of production. Extensive analysis determined it was not beneficial to compete the missile at the prime contractor level after development.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Considerable ground testing and evaluation will continue prior to the first live launch in the fourth quarter. Captive carry missions and jettison flight tests will also precede the first live launch. Two live launches and approximately 20 captive carry missions were performed from the B-1B prior to the end of the fiscal year. The following tests will be conducted on the missile and its subsystems: air vehicle cross section testing, warhead impact fuse sled testing, navigation/guidance accuracy and reliability testing, fin actuator tests, rocket motor qualification testing, and avionic integrity testing. Fabrication of the test missiles will continue.

(5) (U) Program to Completion: After FY 1989, twenty-three planned live launches and approximately twenty-five captive carry/simulated launches will be conducted. Flight testing will be completed in FY 1991. Low rate initial production approval is planned for FY 1990 with full production approval planned for FY 1991.

C. (U) Major Milestones:

Milestones	Dates
(1) (U) Defense Resources Board approval new start	July 1983
(2) (U) System Definition Study contract award	February 1985
(3) (U) Begin Full Scale Development	2nd Quarter FY 1987
(4) (U) Joint Requirements and Management Board Milestone II Review	3rd Quarter FY 1987
(5) (U) First flight	1st Quarter FY 1990
(6) (U) Low rate initial production	3rd Quarter FY 1990
(7) (U) Full rate production	4th Quarter FY 1991
(8) (U) Initial Operational Capability (IOC) *(2nd Quarter FY 1992)	2nd Quarter FY 1993

*Date presented in FY 1987 Descriptive Summary.

(U) Explanation of Milestone Changes

(8) (U) IOC delayed to reduce concurrency between development and production.

Program Element: 63364F
DOD Mission Area: 113 - Airborne Strike

Title: Short Range Attack Missile II (SRAM II)
Budget Activity: 3 - Strategic Programs

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

Budget Activity: 3, Strategic Programs
Program Element: 63364F, Short Range Attack Missile (SRAM) II

Test and Evaluation Data

1. (U) Development Test and Evaluation (DT&E): DT&E on SRAM II will not begin until FY 1989. The DT&E manager will be the Aeronautical Systems Division at Wright-Patterson AFB, OH. Boeing Aerospace and McDonnell-Douglas Astronautics are competing for the program.

2. (U) Operational Test and Evaluation (OT&E). A combined IOT&E/DT&E test program will be conducted during the FSD phase to provide an initial operational effectiveness and suitability assessment in representative operational environments. The goal is to reduce the decision risk at JRMB III, identify potential operational deficiencies, and identify opportunities for further improvement. Combined IOT&E/DT&E testing starts in the second quarter of FY89 and consists of 25 live launches and an as yet unspecified number of captive carry flights. Twenty of the flights will combine DT&E and IOT&E objectives. The last five flights will be conducted using missiles as representative as possible of actual production missiles. These flights will be conducted in a manner that closely resembles actual Emergency War Order sorties. Testing will consist of evaluations in the following areas: The capability of SRAM II to fly all operationally required flight trajectories, carrier aircraft/SRAM II compatability and interoperability, man-machine interactions with SRAM II, navigational capabilities of SRAM II, SRAM II availability, reliability, and maintability, logistics supportability, and SRAM II loading operations. Testing will be conducted using Air Force "hands-on" maintenance to the maximum extent feasible.

3. System Characteristics: The following are reflected in the draft system specification:

Characteristic	Objective/Threshold	Demonstrated
Size (Length/Diameter)(In)	168/15	168/15
Weight (lbs)	1800	TBD
Range (Low launch/high cruise)(NM)		TBD
Speed (Mach)		TBD
Carry Capacity on 180" Launcher	8	

4. (U) Current Test and Evaluation (T&E): DT&E/IOT&E is not currently planned until FY89.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: #63367F
DOD Mission Area: #113 - Airborne Strike

Title: Strategic Relocatable Target Capability (SRT Cap)
Budget Activity: #3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		0	500	16,495	23,723	Continuing	N/A
3368	SRT Capability	0	500	16,495	23,723	Continuing	N/A

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: To maintain a credible deterrent in the 1990s and satisfy national policy enunciated in [ ] This requirement includes the capability to find and target [ ] which can relocate. These relocatable targets are forces or functions which do not have a static location in time of crisis or war. To hold Strategic Relocatable Targets (SRTs) at risk requires a survivable force application capability that permits timely target detection, identification, location, targeting, adaptive planning, battle management, command and control and weapon application. The elements of this capability must be survivable, flexible, and enduring across the conflict spectrum. SAC's [ ] Three primary areas of interest will be developed in this program element: aircraft sensor test and evaluation, artificial intelligence applications, and surrogate SRT development/SRT training.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	0	985	1,572	N/A	Continuing	N/A

EXPLANATION: (U)

- FY 1987: Congressional reduction of funds in FY 1987
- FY 1988: Increase in FY 1988 reflects decision to accelerate program activities.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable

PE: 63367F

Program Element: #63367F Title: Strategic Relocatable Target Capability (SRT Cap)
DOD Mission Area: #113 - Airborne Strike Budget Activity: #3 - Strategic Programs

5. (U) RELATED ACTIVITIES: PE 64326F, Strategic Conventional Standoff Capability (SCSC), project 3076, High Resolution Radar (HRR) demonstration, supports development of an HRR with applicability to the SRT mission. An SCSC/SRT Target Signature Analysis effort ongoing within this PE was transferred to PE 63367F in FY 1987.

6. (U) WORK PERFORMED BY: Rome Air Development Center (RADC) has developed an SRT Sensor Demonstration and Target Signature analysis test plan and will be responsible for scheduling and conducting sensor tests and exploiting collected data. Specific flight tests/demonstrations will be conducted by RADC by contracting with the individual candidate sensor development programs.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable

8. (U) PROJECTS OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3368, Strategic Relocatable Target (SRT) Capability.

A. Project Description: This project develops technology to hold SRTs at risk in the future. Three initiatives are being pursued--aircraft sensor test and evaluation, artificial intelligence applications and surrogate SRT development/SRT training. RDT&E efforts will identify sensors for the SRT mission. Candidate solutions include [redacted] Effort will flight test and gather data to assess [redacted]

Artificial intelligence application development will examine the capability of developing expert knowledge systems capable of processing data to aid crew members in target identification. It will assess capability to process data on-board the aircraft to allow real-time target identification and strike. Surrogate target/SRT training will analyze, [redacted]

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Not Applicable

(2) FY 1987 Program: SRT capability efforts assess ongoing targeting sensor programs and their applicability to the SRT problem. Flight testing will begin against representative [redacted]. Artificial intelligence applications for target assessment with acquired sensor data will commence.

(3) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Flight test of ongoing targeting sensor candidates will continue. [redacted] Auto target cueing development will continue. Approximately nine candidate sensors will be test flown. Rigorous scientific experiments will begin to assess the technical feasibility of developing sensors to detect and identify stationary targets in a high clutter environment. The [redacted] will provide the detailed technical assessment

Program Element: #63367F
DOD Mission Area: #113 - Airborne Strike

Title: Strategic Relocatable Target Capability (SRT Cap)
Budget Activity: #3 - Strategic Programs

essential to support decision making for future weapon systems integration. FY 88 activities will culminate in a [ ] RADC parametric analysis was done to estimate costs.

(4) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Analysis of concept/operation validation results and any necessary follow-up testing/adjustments will complete the initial SRT sensor testing phase. [ ]

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: TBD upon finalization of candidate sensor test scheduled for 1988.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63368F — Title: Air Defense Initiative (ADI) Battle Management Technology
DOD Mission Area: 122 - Strategic Air Defense — Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	0	604	17,139	35,820	Continuing	N/A
3379	Concept Definition	0	0	1,000	1,420	Continuing	N/A
3380	Battle Mgt/Command and Control (C^2) Technologies	0	604	9,139	24,500	Continuing	N/A
3633	Integration Analysis*	0	0	7,000	9,900	Continuing	N/A

*Project 3633 is a new project number and title for effort transitioning from Project 2955, PE 63716F, Atmospheric Surveillance Technology.

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This FY 1987 new start is one of the Air Defense Initiative (ADI) program elements. It funds the advanced development of command and control techniques for defense of North America against the atmospheric threat (including cruise missiles). This potential defense would substantially extend the programmed C^2 for warning/assessment to provide battle management of forces to

This defense requires extensive information fusion and assured connectivity across the conflict spectrum. Enabling technologies for new weapon concepts are identified, developed and tested to demonstrate feasibility, effectiveness and survivability of operational system concepts. This program will provide the analytical basis for Full Scale Development decisions for defensive systems against the atmospheric threat.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	0	2,500	10,500	N/A	Continuing	N/A

EXPLANATION: (U) Congressional reduction changed FY 87. Addition of Project 3633 to work already planned in FY 1988.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: This program is developing Battle Management/Command and Control Systems that will interface with existing and programmed surveillance systems: Over-the-Horizon Backscatter (OTH-B) Radar PE 12417F, North Warning System PE 12412F, and the Joint Surveillance System PE 12325F. This PE will perform system integration for all ADI technology elements and will provide the command and control technology for any system developed from

the ADI work in PE 63738F, ADI Surveillance Technology; PE 63716F, Atmospheric Surveillance Technology; PE 63424F, Cruise Missile Surveillance Technology; PE 63369F, ADI Engagement Technology; and PE 63311N, Anti-Submarine Warfare Technologies for Strategic Defense. This effort will use the battle management test bed being developed by the Strategic Defense Initiative. This activity directly supports National Security Decision Directive-178.

6. (U) WORK PERFORMED BY: This work will be managed by Air Force Systems Command's Electronic Systems Division, Hanscom AFB, MA and Rome Air Development Center (RADC), Griffiss AFB, NY. Additional participation is expected by Space Division, Los Angeles AFS, CA; Ballistic Missile Office, Norton AFB, CA; and Aeronautical Systems Division, Wright-Patterson AFB, OH. Not all contractors have been selected at this time. The MITRE Corp, Bedford, MA has the only contract award made to date.

7. (U) PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3379, Concept Definition. This project evaluates and recommends for Full Scale Development (FSD) the Command and Control (C^2) systems for engaging atmospheric threats (including cruise missiles). Activities will include: (1) defining alternative extensions of the air defense C^2 structure, (2) specifying required technology developments and demonstrations for evaluating C^2 system options and (3) perform necessary system analyses for selection of C^2 system upgrades. The Battle Management/Command, Control and Communication (BM/C^3) test bed developed under the Strategic Defense Initiative will be used. In FY 87, several alternative BM/C^3 systems will be synthesized and tested for their ability to effectively employ defenses againt air threats. In FY 1988 and 1989, the alternative communications systems and survivable command elements will be evaluated and down selected to establish a comprehensive development plan with refined technology guidelines leadin to an FSD decision.

8. (U) PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3633, Integration Analysis: This project develops an integrated system architecture for analysis and selection of technologies to be developed by the Air Defense Initiative (ADI). The architecture development will consider pre-. trans-, and post-attack operational requirements and will evaluate the use of ground-, air- and space-based elements. For the pre-attack phase of conflict, architecture development will concentrate on proliferated surveillance/warning against air breathing penetrators and command and control/weapon systems capable of handling the initial attack. In the trans-attack phase, the concentration will be on survivable surveillance, battle management, and engagement elements. For post-attack, reconstitution capability will be a prime consideration. The architecture development project will consider integration with existing and developmental atmospheric and undersea surveillance and warning systems; command, control, communications and intelligence networks; and anti-air and anti-submarine weapons. Cost and capability analyses will be accomplished under this project to identify combinations of systems meeting requirements for the least cost. The project will be accomplished in parallel with, and will continuously interface with the other projects of this program element, as well as with PEs 63768F, ADI Surveillance Technology, 63369F ADI Engagement Technology and PE 63311N, Anti-Submarine Warfare Technologies for Strategic Defense. In 1988, the initial architecture developed by PE 63716F, Atmospheric Surveillance Technology (AST), in FY 1987, will be iterated as the air defense requirements mature, expanded to include a more comprehensive scope of air defense elements,

and will be updated as new technologies are developed and tested. Tests and full scale development decision criteria will be developed in conjunction with the operating commands to assure sufficient data are available. PE 64235F, Cruise Missile Surveillance Systems, a FY 1990 new start, will perform the FSD of surveillance systems needed for the warning and attack assessment mission. If a policy decision to deploy a comprehensive air defense system is made, FSD program elements will be established for engagement and command and control systems as determined by this architecture project. The architecture effort will be performed with support from the Army, Navy, Office of the Joint Chiefs of Staff, Defense Advanced Research Projects Agency, and the Strategic Defense Initiative Office to assure full application is made from the surveillance, engagement, and command and control technology being developed by these agencies. In FY 1989, this project will complete development of the initial ADI system architecture as a baseline for further technology developments. This architecture will continue to be evaluated and modified to meet the changing air threat and reflect maturing technology. All contracts will be competitively awarded. The selection of candidate system elements for development and testing will continue until an architecture that most economically satisfies the requirements of an advanced air defense system is developed.

9. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

( ) Project: 3380, Battle Management/C^2 Technologies.

A. Project Description: This project integrates, applies, and demonstrates surveillance, engagement and battle management techniques required for rapid, accurate response to atmospheric threats to North America (including cruise missiles). In particular, this project will provide a [ ] Included are emulations which include integration of sensors, air surveillance management, decision aids for the battle commander and communications required for an effective battle management system to assess the threat, develop a responsive plan and assign assets to negate the threat.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Not Applicable.

(2) (U) FY 1987 Program: The program will initiate contract efforts to develop techniques to integrate indication and warning data into knowledge-based systems for aiding decision makers. Design of the communications network to allow full connectivity throughout all phases of a nuclear war will be initiated. Development of models for air defense systems to be evaluated using the Strategic Defense Initiative (SDI) battle management test bed will begin.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Efforts to demonstrate the feasibility of a distributed Command and Control architecture with integrated decision aid/artifical intelligence tools supporting the battle staff decision maker will begin. A multi-shelter test configuration will be established utilizing local Rome Air Development Center test sites. Decisions will be made on the models to be incorporated into the SDI test bed and development of the models will begin. Development of the air defense communications network will continue.

Cost estimates are based on a combination of in-house Government estimates and category V (unevaluated) contractor estimates.

(4) (U) FY 1989 Planned Program and Basis for 1989 RDT&E Request: Selection will be made on the decision aids to be used, and the development of software modules to demonstrate these capabilities will begin. A communications network architecture will be selected and work on a demonstration test system will begin. Development of modules to process the communications data will also begin. Cost estimates are based on a combination of in-house Government estimates and category V (unevaluated) contractor estimates.

(5) Program to Completion: Efforts begun in FY 1989 will continue until the decision aid software and communications network can be demonstrated. Air defense modules will be completed so that an integrated air and ballistic missile defense battle management system can be simulated on the SDI developed test bed. Also detailed design studies will be initiated for a combined air surveillance/target engagement capability by [

] The concept involves slaving an [

]

C. (U) Major Milestones:

Milestones	Dates
(1) (U) Test Bed Model Contracts Awarded	January 1987
(2) (U) Decision Aid Contract(s) Awarded	March 1987
(3) (U) Communications Network Design Contracts Awarded	May 1987
(4) (U) Selection of Test Bed Models	January 1988
(5) (U) Selection of Decision Aids and Communications Network	FY 1989
(6) ( ) Demonstration of Air Defense Portion of Test Bed	[
(7) ( ) Demonstration of Air Defense Battle Management System	]
(8) (U) Demonstration of Fire Control System	TBD

10. (U) COOPERATIVE AGREEMENTS: No specific agreements exist at this time. Under the Memorandum of Understanding on the Modernization of North American Air Defense, signed in 1985, there is provision for cooperative research between the US and Canada on advanced air defense technologies. Specific joint research projects have not been negotiated at this time, but will be considered.

ON, ?

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63369F Title: Air Defense Initiative (ADI) Engagement Technology
DOD Mission Area: 122 - Strategic Air Defense Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	0	508	13,222	35,035	Continuing	N/A
3381	Concept Analysis	0	0	3,000	3,000	Continuing	N/A
3382	Intercept Vehicle Technology	0	108	4,222	10,900	Continuing	N/A
3383	Missile Seeker Technology	0	400	6,000	21,135	Continuing	N/A

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This FY 1987 new start is one of the Air Defense Initiative (ADI) program elements. It funds the advanced development and demonstration of combat engagement technologies for defense of North America against atmospheric threats (including cruise missiles). These technologies would provide the basis for early 1990s decisions concerning full scale development of wide area, long range, high speed intercept capability against designated atmospheric threats--responsive to large and small scale attacks. [ ] Enabling technology for new weapon concepts are identified, developed and tested to demonstrate feasibility, effectiveness and survivability of operational systems concepts.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	0	2,100	13,500	N/A	Continuing	N/A

EXPLANATION: (U) Congress did not fund the full request in FY 1987.

4. (U) OTHER APPROPRIATION FUNDS: Not applicable.

5. RELATED ACTIVITIES: This technology development and demonstration program will transition the technologies in current exploratory development programs to lead to full scale development of systems to engage aircraft and cruise missiles. Advanced development efforts feeding specific components to this effort are 63205F Flight Vehicle Technology, 63211F Aerospace Structures and Materials, 63216F Advanced Turbine Engine Gas Generator, 63245F Advanced Fighter Technology Integration, [ ] 63601F Conventional Weapons Technology, 63308N Air-to-Air Missile Technology Demonstration, 63318N Advanced Surface-to-Air Missiles and PE 62711E, Experimental Evaluation of Major Innovative Technology. PE 63205F (Flight Vehicle Technology), PE 63216F (Advanced Turbine Engine Gas Generator) and PE 63601F (Convential Weapons) activities distinctly applicable to Air Defense will be incorporated into this program in FY 1988. This program will be closely worked with complementary technology activities in PE 63368F, Air

Defense Battle Management Technology, PE 63716F Atmospheric Surveillance Technology, and PE 63424F Cruise Missile Surveillance Technology.

6. (U) WORKED PERFORMED BY: This work will be managed by Air Force Systems Command's Aeronautical Systems Division, Wright-Patterson AFB, OH; Air Force Wright Aeronautical Laboratories, Wright-Patterson AFB, OH; and Armament Division, Eglin AFB, FL. Additional participation is expected by Space Divison, Los Angeles AFS, CA, and Ballistic Missile Office, Norton AFB, CA. Contractors will be selected competitively.

7. (U) PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3381, Concept Analysis. This project evaluates and recommends weapon/armament systems for full scale development. Activities will include: (1) defining alternative systems (2) specifying technology activity required for evaluating system feasibility and performance; (3) performing necessary system analysis for selection of high payoff weapons. Architecture evaluation will consider air-, ground-, and space-deployed weapons. The architecture will be designed to provide performance through all phases of conflict. In FY 1987, the systems will be synthesized and tested for their ability to defend against the projected threat. In FY 1988, and continuing through FY 1992, alternative systems will be evaluated and down selected to establish a comprehensive development plan with refined technology guidelines leading to a Full Scale Development decision.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3382, Intercept Vehicle Technology.

A. (U) Project Description: This project develops and demonstrates the feasibility, effectiveness, and operational value of aerospace vehicle concepts which will be used to engage cruise missiles and aircraft. Trade studies will be conducted to determine which of the existing concepts are most cost-effective and technically feasible. Vehicle flight systems evaluation includes application of advanced aerodynamic theory to existing interceptors, modification to existing sensors to address the high altitude look down/shoot down problem, and internal layouts to carry a variety of kill mechanisms. The propulsion concept definition task will examine various mission profiles including air and ground launch scenarios with the goal of defining a moderate and low risk propulsion concept. Various ramjet and combine cycle engine concepts will be investigated. Flight validation of the selected concepts will prove the feasibility of destroying either single or multiple cruise missile carriers and/or cruise missiles per launch of the intercept vehicle.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Not Applicable

(2) FY 1987 Program: Trade studies for selection of baseline intercept vehicles in the hypersonic and supersonic flight regimes will be performed. A concept definition contract will be performed. A concept definition

contract will be awarded for design of a long range vehicle with[ ]for attacking cruise missiles and carriers at extended ranges. The avionics for such a vehicle will be jointly funded by this Program Element and the Defense Advanced Research Projects Agency. Inlet and thermal protection material development for sustained super sonic (mach 4.0-6.0) flight will begin.

(3) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Development of[ ]for a long range, high speed vehicle (including propulsion, thrust vector controls, seekers, and separation devices) will begin. Modification/design of a booster rocket for the long range vehicle will start in FY 1988. In late 1988 a concept for the long range vehicle will be chosen and development will begin. In the supersonic area, tasks begun in FY 1987 will continue. The cost estimates are based on a combination of in-house Government estimates and category V (unevaluated) contractor estimates.

(4) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The long range vehicle developments begun in FY 1988 will continue. The booster rocket will have its first test firing in FY 1989. Development of[ ]mechanical devices will begin. Ground testing of the supersonic system and development of ramjet/scramjet engines for air testing also will begin. The cost estimates are based on a combination of in-house Government estimates and category V (unevaluated) contractor estimates.

(5) Program to Completion: Prototypes of both the long range vehicle and supersonic[ ]will be built and flight tested against[ ]

C. (U) Major Milestones

Milestones	Dates
(1) ( ) Supersonic Vehicle Ground Test	[ ]
(2) ( ) Long Range Vehicle Design Completion	
(3) ( ) Separation Demonstration	

9. (U) PROJECT OVER $10 Million In FY 1988 AND/OR FY 1989:

(U) Project: 3383, Missile Seeker Technology

A. Project Description: This project develops and demonstrates the feasibility effectiveness, and operational value of multi-spectral, multi-mode seeker concepts capable of[ ] precisely guiding its host missile to an intercept, and reliably fuzing the warhead within lethal range of the target. Concepts will be demonstrated in extensive hardware-in-the-loop simulation and limited flight tests to assess their technical maturity and operational payoff for use on interceptor missiles.

B. (U) Program Accomplishments and Future Efforts:

Program Element: 63369F Title: Air Defense Initiative (ADI) Engagement Technology
DOD Mission Area: 122 - Strategic Air Defense Budget Activity: 3 - Strategic Programs

(1) (U) FY 1986 Accomplishments: N/A

(2) FY 1987 Program: Preliminary designs of missile seeker concepts for [ ] will be transitioned from PE 63601, Conventional Weapons. Contracts will be awarded for designs of multi-mode seekers for "fire and forget" missile systems. These contracts will include both multi-band radar and radar/infrared seeker concepts. Not only will the effectiveness of these combinations be evaluated, but also development difficulties in packing various combinations in a single seeker design.

(3) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: A seeker design for [ ] will be selected and development of a demonstration system begun. The seeker design will be constrained to fit on an AIM-120 airframe for the demonstration. Development of [ ] that will be required for a multi-mode seeker will begin. Materials that will allow seeker operation at high supersonic and hypersonic cruise speeds will also be examined. The cost estimates are based on a combination of Government estimates and category V (unevaluated) contractor estimates.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Seeker design and materials development efforts begun in FY 1988 will continue. The cost estimates are based on a combination of Government estimates and category V (unevaluated) contractor estimates.

(5) Program to Completion: The demonstration seeker design will be completed in FY 1991. In FY 1992 and 1993 the seeker will be tested on a ground test fixture and modifications made as required. The full-up seeker will be demonstrated in [ ]

C. (U) Major Milestones

Milestones	Dates
(1) (U) Design concept Selection	July 1988
(2) (U) Design Complete	FY 1992
(3) ( ) Initial Ground Test	[ ]
(4) ( ) Air-Launched Demonstration	[ ]

10. (U) COOPERATIVE AGREEMENTS: No specific agreements exist at this time. Under the Memorandum of Understanding on Modernization of the North American Air Defense System, signed in 1985, there is provision for cooperative research between the US and Canada on advanced air defense technologies. Specific joint research projects have not been negotiated at this time, but will be considered.

FY 1988/FY 1989 DESCRIPTIVE SUMMARY

Program Element: 63716F Title: Atmospheric Surveillance Technology (AST)
DOD Mission Area: 122 - Strategic Air Defense Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	8,284	14,137	8,695	1,604	0	37,559
2955	Architecture Development	284	1,137	0*	0	0	2,002
2956	Technology Development and Demonstration	8,000	13,000	8,695**	1,604**	0	35,557

* Work moved to Project 3633 of PE 63368F Air Defense Initiative (ADI) Battle Management Technology.
** Work being phased over to Project 3640 of PE 63738F, ADI Surveillance Technology.

2. ( ) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Atmospheric Surveillance Technology, one of the Air Defense Initiative (ADI) program elements, is an advanced development program to conduct studies, develop an architecture and demonstrate surveillance technologies for a future air defense system. This system will require survivable surveillance sensors which have improved capabilities against low observable air-breathing threats including cruise missiles. Weapon systems and battle management technologies to provide a level of defense against atmospheric threats similar to that provided by the Strategic Defense Initiative for ballistic missile threats will be developed and demonstrated by companion program elements. The air defense system must also remain effective through all phases of nuclear conflict. The AST program evaluates existing technology, fabricates experimental hardware, and conducts feasibility demonstrations for application to a survivable air surveillance and defense system. Serious deficiencies currently exist for tactical warning of aircraft and cruise missile attacks of North America. These deficiencies will be greatly alleviated in the early 1990s by the deployment of new radars in Alaska (SEEK IGLOO Program), fielding of the North Warning System (Distant Early Warning Line Upgrade), and deployment of Over-the-Horizon Backscatter (OTH-B) radars. These radar systems will provide cost-effective warning of an initial attack by the early 90's generation of Soviet air threats, but are not survivable in a nuclear exchange and may have[

] This program, and its successor PE 63738F, provides the link between exploratory development projects and Full Scale Development programs that will ultimately lead to a survivable air defense system for deployment in the late 1990s. Any new capability will be integrated with and complement our ongoing atmospheric tactical warning programs to provide full deterrence against an air-breathing attack upon North America.

Program Element: 63716F
DOD Mission Area: 122 - Strategic Air Defense

Title: Atmospheric Surveillance Technology (AST)
Budget Activity: 3 - Strategic Programs

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
RDT&E	4,851	32,024	30,604	N/A	Continuing	N/A

EXPLANATION: (U) FY 1986 funds added for Low Cost Alternative to the Airborne Warning and Control System (AWACS) study. Congress did not appropriate the funds requested in FY 1987. The work started in this PE will transition into PE 63768F, Air Defense Initiative (ADI) Surveillance Technology, and 63368F, ADI Battle Management Technology, in FY 1988 and 1989 phasing out this PE.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: This technology development and demonstration program will transition the technology developed in current exploratory development programs to full scale development efforts for systems with flexible and survivable capabilities for bomber and cruise missile surveillance. This program will be conducted in coordination with PE 63424F, Cruise Missile Surveillance Technology, which addresses advanced development of space-based sensors for detection of cruise missiles; PE 63368F, ADI Battle Management Technology; PE 63369F, ADI Engagement Technology; and PE 63768F, ADI Surveillance Technology.

6. (U) WORK PERFORMED BY: This work will be managed by Air Force Systems Command's Electronic Systems Division, Hanscom, AFB, MA; and Rome Air Development Center (RADC), Griffiss AFB, NY. As this effort is a phased development effort, not all contractors have been selected at this time. Those currently under contract are: Syracuse Research Corp., Syracuse, NY (2956); IBM Corp, Owego, NY (2956); Science Applications International Corp, McLean, VA (2955); and MITRE Corp., Bedford, MA (2955).

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2956, Technology Development and Demonstration.

A. (U) Project Description: This project evaluates available technology and develops promising ground and air-based surveillance sensor candidates to the point where experiments against single and multiple targets can be performed. The impact of low observable air-breathing threats will be assessed to assure effective surveillance over the entire range of future threat vehicles. Utility appraisal will include the pre-, trans-, and post-attack phase of conflict.

PE: 63716F

B. (U) Program Accomplishments and Future Efforts:

(1) FY 1986 Accomplishments: Technology developments begun in FY 1985 and continued in FY 1986, included signal processing techniques for application of [ ] and data fusion techniques. Non-real time testing with [ ] Studies of lower-cost surveillance aircraft alternatives to the Airborne Warning and Control System (AWACS) were conducted. These studies identified the requirement for an airborne phased array radar to be developed beginning in FY 1987 by this project.

(2) FY 1987 Program: Development work on the [ ] will continue throughout FY 1987. The complete receiver and data processing system will be incorporated into a single van, taken to a test site near Eglin AFB and tested with targets of opportunity on the Eglin test range. [ ] These data will be used to modify the design to improve performance and gather range, accuracy, and probability of detection data for the architecture project. Efforts to develop a phased array Ultra-High Frequency (UHF) or low L-band radar to demonstrate an airborne early warning system for long range detection of [ ] will begin in FY 1987. the radar will be developed so that it could be carried by a fixed wing aircraft (such as the C-130 or C-17) or by an airship should the Navy airship program lead to a production decision. Contracts for radar design and signal data processing system design will be awarded to multiple contractors to assure development in a competitive environment. Explore technologies required to support adjunct sensors [ ] that will enhance radar performance.

(3) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Plans for FY 1988 include the demonstration of sensor systems and operational evaluation by the potential operating commands. [ ] van-mounted demonstration system will be used at numerous locations to test, the sensor under a variety of terrain and emitter density conditions. Drones and cruise missiles will be flown in the vicinity of the system to test detection and tracking capabilities with single and multiple emitter configuration. Results of these tests will determine if a groundbased system should be put into engineering develp ment and provide the basis for writing the system specification for the engineering development program. Cost estimates are based on a combination of in-house Government estimates and Category V (unevaluated) contractor estimates.

(4) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Testing of the [ ] van mounted system will be completed and a decision on Full Scale Development will be made. Cost estimates are based on a combination of in-house Government estimates and Category V (unevaluated) contractor estimates.

(5) (U) Program to Completion: Not Applicable.

C. (U) Major Milestones:

Milestones	Dates
(1) (U) Draft Architecture	July 1987
(2) ( ) Demonstration of Van-mounted Sensor	August 1987
(3) ( ) Completion of Van-mounted Sensor Testing	March 1989

(U) Explanation of Milestone Changes: Not Applicable.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 and FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: No specific agreement exists at this time. Under the Memorandum of Understanding on Modernization of North American Air Defense, signed in 1985, there is provision for cooperative research between the US and Canada on advanced air defense technologies. Specific joint research projects have not been negotiated at this time, but will be considered.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63717F
DOD Mission Area: 205 - Physical Security Systems

Title: Technical On-Site Inspection (TOSI)
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		0*	6,513	3,819	3,813	Continuing	N/A

* Initial work covered by reprogramming a total of $4.5 million into PE 63714F during FY 1984-86.

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program will design, fabricate and test an engineering model of a Technical On-Site Inspection (TOSI) system[ ] The TOSI system is a[ ] The program will complete and refine the baseline system concept and its sensor components. It will also design, develop, acquire, integrate, and test the system (including the construction and operation of a full scale test facility). This program responds to Deputy Secretary of Defense direction to develop technology necessary to construct a TOSI System. [ ]

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	0	9,850	3,931	N/A	11,607	N/A

EXPLANATION: FY 1987 RDT&E reduction resulted from Congressional action on this program. Initial work covered by reprogramming $4.5 million into PE 63714F during FY 1986.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: Funding for this activity was previously provided under PE 63714F, DOD Physical Security Equipment-Exterior.

6. (U) WORK PERFORMED BY: This program is managed by the Physical Security Systems Directorate, Electronics Systems Division, Hanscom AFB, MA. The work is performed by Sandia National Laboratory, Albuquerque, NM.

Program Element: 63717F
DOD Mission Area: 205 - Physical Security Systems

Title: Technical On-Site Inspection (TOSI)
Budget Activity: 3 - Strategic Programs

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 63717F, Technical On-Site Inspection (TOSI)

A. Project Description: This project provides a system that, This project will design, fabricate and test an engineering model of a

The program will complete and refine the baseline system concept and its sensor components. It will also design, develop, acquire, integrate and test the system (including the construction and operation of a full scale engineering model).

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Concept studies were completed and initial design and testing at the component level was begun. FY 1986 efforts are funded under PE 63714F. The TOSI program becomes a separate effort beginning in FY 1987.

(2) (U) FY 1987 Program: Development continued for the overall TOSI system. Candidate components were acquired and integrated into a system configuration. Test and evaluation at the system and subsystem level began December 1986. Cost estimates are Category III Budgetary cost estimates and were updated in September 1986.

(3) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Test and Evaluation of the of a TOSI system will continue. Development efforts to be initiated include to insure integrity of the system. Development of will be started.

(4) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Test and Evaluation of the of a TOSI system will continue. Development efforts to be continued include to insure integrity of the system. Development of will be continued.

(5) (U) Program to Completion: This is a continuing program that will develop technologies applicable to the TOSI effort and provide a demonstration testbed for TOSI evaluation purposes.

Program Element: 63717F
DOD Mission Area: 205 - Physical Security Systems

Title: Technical On-Site Inspection (TOSI)
Budget Activity: 3 - Strategic Programs

C. (U) Major Milestones:

Milestones	Dates
(1) ( ) Component testing; go-ahead for completion of [ ] *(March 1987)	August 1986
(2) ( ) Complete [ ] final design of operational test facility *(September 1988)	December 1986

*Date presented in FY 1987 Descriptive Summary

(U) Explanation of Milestone Change

(1) ( ) Program accelerated by OSD to have [ ] available for [ ]

(2) ( ) Program accelerated by OSD to have [ ] available for [ ]

8. (U) PROJECT OVER $10 MILLION IN FY 1987 AND/OR FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63735F
DOD Mission Area: 333 - Strategic Command and Control

Title: WWMCCS Architecture
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		7,194	1,873	282	289	Continuing	N/A
2188	Air Force Worldwide Military Command and Control System, Systems Engineering Planning and Support	7,194	1,873	282	289	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Air Force Worldwide Military Command and Control System (WWMCCS) Architecture program ensures Air Force interests are considered in the implementation of command, control, and communications (C^3) upgrades. It coordinates efforts to ensure interoperability between Air Force systems and systems of the other services. The program's objectives are to resolve planning and system engineering problems associated with the integration of existing and planned assets of Air Force strategic C^3 systems.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	7,831	2,224	2,525	N/A	Continuing	N/A

EXPLANATION: (U) FY 1988, 1989: Funding to support system engineering support for Jam Resistant Secure Communications (JRSC) and Secure Conferencing Program (SCP) programs remains. All funding for Strategic C^3 system Architecture was withdrawn to support higher priority Air Force Programs.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: Related program elements are PE 12431F, Defense Support Program, which provides the mobile ground terminals with which Jam Resistant Secure Communications (JRSC) equipment will interface; PE 33605F, Satellite Communications Terminals, which provides site preparation, interconnect operations and maintenance, and manpower for JRSC terminals at Air Force sites; PE 41840F, Military Airlift Command (MAC) Command & Control (C^2) System which funds for research and development of enhanced C^2 capabilities for MAC; PE 33126F, Defense Communications System (DCS) Long Haul Communications, which provides the procurement funds for the Secure Conferencing Project; PE 64312F/11215F, Intercontinental Ballistic Missile (ICBM) Modernization; and PE 12332F, Alaskan Air Command C^2 Upgrade. All of the above require systems engineering and interface definition for implementation at Air Force installations.

6. (U) WORK PERFORMED BY: Electronic Systems Division, Hanscom Air Force Base, MA, manages the JRSC program for the Air Force. The Air Force Worldwide Military Command and Control System (AFWWMCCS) Program Office, Electronic Systems Division, Hanscom Air Force Base, MA, conducts 70 percent of the remaining work in-house with MITRE Corp., Bedford, MA technical support. A number of small contracts for systems engineering and planning support have been used for the balance of the work. Contracts have been awarded to the following companies: Analytic System Engineering Corp., Burlington, MA; Information Systems and Networks, Washington DC; and SRI International, Menlo Park, CA. Total contract value is $3.1M.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2188, Air Force Worldwide Military Command and Control System (WWMCCS) Systems Engineering Planning and Support

A. (U) Project Description: This project provides intersystem engineering support in response to Air Force generated requirements addressing the integration, standardization, and interoperability of communications, command and control centers, and sensors for Air Force strategic forces. This project also provides for improvements recommended in the WWMCCS Architecture directed by the Deputy Secretary of Defense in 1976.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Planning work continued for the Alaskan Air Command (AAC) to develop a strategic communications architecture to support crisis and wartime requirements for the Alaska - Aleutian theater of operations. The program office initiated a task to develop a prototype knowledge-based system (KBS) to assist Military Airlift Command (MAC) planners establish concepts of operations for providing airlift support to specfic force deployments. Support to the Ballistic Missile Office (BMO) continued with the definition of higher authority communications connectivity to the small ICBM launchers/launch control centers. Also for BMO, the program office developed design options for a modular command, control and communications (C^3) suite. Strategic command and control and ballistic missile tactical warning/attack assessment VANGUARD sub-mission plans were prepared for the Air Force Systems Command (AFSC). The program office continued to define an integrated terrestrial/space C^3 capability to support the national aerospace plane operations.

(2) (U) FY 1987 Program: Work on the Alaskan Air Command (AAC) strategic communications architecture continued in the following areas: preparation of a technical assessment/cost estimate for Alaskan theater Command, Control & Communication (C^3), requirements analysis for information management system design and implementation at critical AAC bases and operating locations and initiation of a concept definition study for a far-term solution to the problem of providing a robust infrastructure for all Alaskan theater forces. Efforts to develop and refine the prototype Knowledge-based System (KBS) for Military Airlift Command (MAC) airlift planners continued. Studies identified and provided alternative solutions to integrate the KBS and other advanced decision aids into existing and future MAC data handling systems. Support to Ballistic Missile Office emphasized development of a meteor burst communications database and evaluation of capabilities to achieve timely delivery of emergency action messages to the small Intercontinental Ballistic Missile (ICBM) force. Support to Air Force System Command (AFSC) in preparation of submission area VANGUARD plans will continue. The program office continued to develop C^3 concepts to support deployment and operation of the national aerospace plane.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: FY 1988 work planned is to provide quick reaction systems engineering support for the integration of Jam Resistant Secure Communications (JRSC) terminals at satellite ground stations supporting missile attack warning/attack assessment systems and command and control facilities. Cost estimate is Category IV, planning.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: FY 1989 work planned is to continue the quick reaction systems engineering support for the integration of JRSC terminals. Cost estimate is Category IV, planning.

(5) (U) Program to Completion: This is a continuing program. System engineering support will continue u all JRSC terminals are installed.

C. (U) Major Milestones:

Milestones	Dates
(1) (U) Transition of small ICBM Worldwide Military Command and Control System terminal development to the product program office completed.	March 1987
(2) (U) Tactical assessment/Cost estimate for Alaskan C^3 completed.	July 1987

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not applicable.

9. (U) COOPERATIVE AGREEMENTS: Not applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63738F Title: Air Defense Initiative (ADI) Surveillance Technology
DOD Mission Area: 122 - Strategic Air Defense Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	0	0	85,679	138,900	Continuing	N/A
3640	Ground/Air Based Surv. Tech. *	0	0	59,054	108,266	Continuing	N/A
3641	Space Based Surv. Tech. **	0	0	25,625	26,834	Continuing	N/A
3010	Teal Ruby Mission Planning ***	0	0	1,000	3,800	Continuing	N/A

* Project 3640 is a new project number and title for effort transitioning from Project 2956, PE 63716F, Atmospheric Surveillance Technology.
** Project 3641 is a new project number and title for effort transitioning from Project 2123, PE 63424F, Cruise Missile Surveillance Technology.
*** Project 3010 funds previously contained in PE 63424F.

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: ADI Surveillance Technology, is an advanced development program to develop and demonstrate surveillance technologies for a future air defense system. This system will require survivable surveillance sensors which have improved capabilities against low observable air-breathing threats including cruise missiles. Weapon systems and battle management technologies to provide a level of defense against atmospheric threats similar to that provided by the Strategic Defense Initiative for ballistic missile threats will be developed and demonstrated by companion program elements. Such a future air defense system must also remain effective through all phases of nuclear conflict. The ADI Surveillance Technology program evaluates existing technology, fabricates experimental hardware, and conducts feasibility demonstrations for application to a survivable air surveillance and defense system. Serious deficiencies currently exist for tactical warning of aircraft and cruise missile attacks of North America. These deficiencies will be greatly alleviated in the early 1990s by the deployment of new radars in Alaska (SEEK IGLOO Program), fielding of the North Warning System (Distant Early Warning Line Upgrade), and deployment of Over-the-Horizon Backscatter (OTH-B) radars. These radar systems will provide cost effective warning of an initial attack by the early 90's generation of Soviet air threats, but are not survivable in a nuclear exchange.

This program, and its predessor, PE 63716F, provide the link between exploratory development projects and full scale development programs that will ultimately lead to a survivable air defense system for deployment in the late 1990s. Any new capability will be integrated with and complement our ongoing atmospheric

tactical warning program to provide full deterrence against an air-breathing attack upon North America.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: There was no Descriptive Summary for this PE in FY 1987 as it is a new program element. The following table shows the project funding as shown in the FY 1987 Descriptive Summaries of their former program elements.

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
2956	Technology Development and Demonstration (PE 63716F)	4,278	29,712	27,704	N/A	Continuing	N/A
2123	Cruise Missile Surveillance Technology (PE 63424F)	3,655	12,850	25,625	N/A	Continuing	N/A
3010	Teal Ruby Mission Planning (PE 63424F)	7,600	4,000	1,000	N/A	0	33,392

EXPLANATION: (U) Project 2956 FY 1988 transistion to Project 3640 and funding increase reflects Department of Defense decision to pursue development and test of the airborne phased-array radar for an early 1990's FSD decision. Project 3010 changes due to delays in Shuttle program and decision to delay the Teal Ruby launch until the 1990's.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: This technology development and demonstration program will transition the technology developed in current exploratory development programs to full scale development efforts for systems with flexible and survivable capabilities for bomber and cruise missile surveillance. This program continues work begun in PE 63716F, Atmospheric Surveillance Technology, and PE 63424F, Cruise Missile Surveillance Technology. This program will be conducted in coordination with the other ADI programs, PE 63368F, ADI Battle Management Technology; PE 63369F, ADI Engagement Technology, and PE 63311N, Anti-Submarine Warfare for Strategic Defense.

6. (U) WORK PERFORMED BY: This work will be managed by Air Force Systems Command's Electronic Systems Division, Hanscom, AFB, MA; Rome Air Development Center (RADC), Griffiss AFB, NY; and Air Force Space Technology Center (AFSTC), Kirtland AFB, NM. Contractors have not been selected at this time.

7. (U) PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3010, Teal Ruby Mission Planning. This project develops mission plans for the Teal Ruby experiment, develops mission data reduction software, and analyzes the mission data. Mission planning and data reduction software were initiated in FY 1984 and will be completed in FY 1987 under PE 63424F. The Teal Ruby experiment will fly on the

Space Shuttle. The originally planned FY 1987 launch is now projected (manifested) for FY 1990 as a result of the Shuttle accident. The Teal Ruby experiment is a joint Defense Advanced Research Project Agency and Air Force development to assess a space-based capability for infrared detection of airborne targets. The Teal Ruby spacecraft will provide the initial demonstration of a spaceborne infrared sensor designed to acquire, identify, and track aircraft. During Teal Ruby sensor's year of on-orbit life, it will collect measurements on signatures from target aircraft against a variety of backgrounds. These data are important to eventual development of a space-based, wide area surveillance system.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3640, Ground/Air Based Surveillance Technology

A. (U) Project Description: This project evaluates available technology and develops promising ground and air-based surveillance sensor candidates to the point where experiments against single and multiple targets can be performed. The impact of low observable air-breathing threats will be assessed to assure surveillance effectiveness over the entire range of future threat vehicles. Utility appraisal will include the pre-, trans-, and post-attack phases of conflict.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Not Applicable.

(2) (U) FY 1987 Program: Not Applicable.

(3) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Plans for FY 1988 include the demonstration of sensor systems and operational evaluation by the potential operating commands. The van-mounted demonstration system developed by PE 63716F, Atmospheric Surveillance Technology, will be used at numerous locations to test the sensor under a variety of terrain and emitter density conditions. Drones and cruise missiles will be flown in the vicinity of the system to test detection and tracking capabilities with single and multiple emitter configurations. Results of these tests will determine if a groundbased system should be put into engineering development and provide the basis for writing the system specifications for the engineering development program. Examination of the technical feasibility of an airborne version will begin. The airborne system will be examined for use as both an independent sensor and as an adjunct sensor with the phased array radar. Design of an airborne phased array radar at Ultra-High Frequency (UHF) or L-band and its signal/data processing subsystem, started by PE 63716F in FY 1987, will continue during FY 1988. This radar will be developed so that it can be carried by a fixed wing aircraft (C-130 or C-17, for example) or by an airship should the Navy airship program lead to a production decision. Refine and select technologies in support of airborne radar adjunct sensors. Cost estimates are based on a combination of in-house Government estimates and Category V (unevaluated) contractor estimates.

(4) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Testing of the van mounted system will be completed and a decision on full scale development will be made. Testing in FY 1989 will

concentrate on areas with [ ] to determine threshold capabilities. The airborne phased array radar effort will begin fabricating the demonstration radar. A brass-board model will be built and mounted on a test aircraft to allow testing of the radar in a look-down mode against drones of cruise missile size over all terrain conditions. A decision will be made on the vehicle to carry the test radar. Examination of use of higher frequency bands in a multi-band phased array radar (to provide better tracking of detected targets) will begin. Design of specific adjunct sensors to enhance radar performance will begin. Development of [ ] for the ground based [ ] system will also begin in FY 1989, as will hybrid bistatic radar sensors (transmitter and receiver on different platforms). Cost estimates are based on a combination of in-house Government estimates and Category V (unevaluated) contractor estimates.

(5) Program to Completion: Airborne basing modes for [ ] sensors will continue to be developed and demonstrated. Passive sensors and unattended processors will be developed and field tested. Development of an airborne phased array radar sensor will continue with demonstration/test in FY 1990 through 1992. Hybrid systems (transmitter and receiver on different platforms) will continue to be developed in FY 1990 through 1992. Ground based, airborne, and space based platforms will be examined for use in hybrid systems. Drone aircraft capable of flights lasting several days and airships with mission durations of several months will be examined as possible airborne platforms. The data fusion process and multispectral data analysis problems will be addressed and solutions demonstrated. System specifications for sensor and data processing systems for engineering development will be the product of this effort. This is a continuing effort.

C. (U) Major Milestones:

		Milestones	Dates
(1)	( )	Test of Van-mounted [ ] Sensor	October 1987-March 1989
(2)	( )	Demonstration of [ ]	April 1988
(3)	( )	Demonstration of [ ]	June 1988
(4)	(U)	Flight Demonstration of Airborne Early Warning Radar Sensor	FY 1992
(5)	(U)	Demonstrations of other Sensor Technologies	TBD

(U) Explanation of Milestone Changes: Not Applicable.

9. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3641, Space Based Surveillance Technology

A. Project Description: This project evaluates feasible concepts for cruise missile detection and tracking from space platforms, develops the key technologies, demonstrates performance, and provides a confident basis for any future decisions on a full-scale system development. The Air Force initiated sensor technology concept assessments

and infrared, radar, and visible phenomenology measurements associated with cruise missile flights against low-contrast earth backgrounds. Promising concepts will be selected for flight testing. Development technology test and component feasibility demonstrations will support an [ ] full scale development decision and transition of the project to the Cruise Missile Surveillance Sensors program (PE 64235F).

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Not Applicable.

(2) (U) FY 1987 Program: Not Applicable.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The technology development program will continue, leading to selection of a single satellite concept by the end of the year. Activities will include selection of operational detection frequencies; design, fabrication, and testing of detector modules; investigation of electronic countermeasures, clutter, and false target issues; and implementation of a test bed. Project Orion (a Special Access Required (SAR) program) will be developed and tested as an ADI sensor under this project beginning in FY 1988. Cost estimates are based on most likely engineering estimates and are thus Category IV (planning).

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Candidate space-based designs supporting bistatic measurement, low-observable detection/tracking, and specific detector module/array configurations will be fabricated and initially tested. Also included is the design and fabrication of required test fixtures/facilities. The cost estimates are based on most likely engineering estimates and are thus Category IV (planning).

(5) Program to Completion: This is a continuing program. The technology development phase will lead to ground-based demonstrations in [ ] with options for space demonstrations. Successful completion of these demonstrations will lead to the transition of initial sensor technology to full scale development (FSD) and later on-orbit prototype demonstration.

C. (U) Major Milestones:

		Milestones	Dates
(1)		Begin Demonstration Activities	[ ]
(2)	(U)	Complete Teal Ruby Data Collection	FY 1991
(3)	(U)	Complete Teal Ruby Data Analysis	FY 1991
(4)	( )	Transition Initial Technology to FSD	[
(5)	( )	Prototype Flight Demonstration	]

(U) Explanation of Milestone Changes: Not Applicable.

10. (U) COOPERATIVE AGREEMENTS: No specific agreement exists at this time. The Memorandum of Understanding on Modernization of North American Air Defense, signed in 1985, makes provision for cooperative research between the United States and Canada on advanced air defense technologies. Specific joint research projects have not been negotiated at this time, but will be considered.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64216F
DOD Mission Area: 331 - Strategic Command and Control

Title: World Wide Airborne Command Post (WWABNCP) System Replacement
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		0*	0*	13,695	13,796	Continuing	N/A

* Funding for FY 1986 and FY 1987 under PE 11312F, Post Attack Command and Control System

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Provides an advanced airborne command post and command and control suite[ ]for the Commander-in-Chief of the Strategic Air Command[ ]
This program will provide the[ ]in the WWABNCP System Replacement Justification for Major System New Start and the[ ]

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	3,993	14,798	28,045	N/A	Continuing	N/A

EXPLANATION: (U) Funds shown are from the FY 1987 Descriptive Summary for Post Attack Command and Control System (PE 11312F). Funds for WWABNCP Replacement were changed to PE 64216F for FY 1988 and on. Funding cuts reflect adjustments made to align program funding to a slip in the initial operational capability (IOC) from FY 1995 to FY 1997. FY 1986 and FY 1987 funding for WWABNCP System Replacement are in PE 11312F.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable

5. RELATED ACTIVITIES: The following Program Elements support the Worldwide Airborne Command Post System Replacement: Air Force Satellite Communications Program, PE 33601F; System Survivability, PE 64711F; Electromagnetic Radiation Test Facilities, PE 64747F; Air Force Support to Minimum Essential Emergency Communications Network, PE 33131F; Milstar, PE 33603F; Post Attack Command and Control System, PE 11312F; [ ]and[ ] A memorandum of agreement between the Air Force and the Army will be accomplished to insure no duplication of efforts or overlapping of responsibility.

6. **WORK PERFORMED BY:** Aircraft selection and modification, and command and control suite integration are the responsibility of the WWABNCP System Replacement System Program Office (SPO), Air Force Systems Command, Electronic Systems Division (ESD) located at Hanscom AFB, MA. The command and control suite will be [ ] (details require special access).

7. (U) **PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:** Not Applicable

8. (U) **SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:**

(U) **Project: 64216F, WWABNCP System Replacement**

A. **Project Description:** This program will be a Major System New Start in FY 1988. The WWABNCP System Replacement SPO will develop an advanced airborne command post and integrate a command and control (C2) suite capable of providing an enduring and survivable command and control capability for the Commander-in Chief, Strategic Air Command (CINCSAC) well into the 21st Century. Program includes RDT&E funds for procuring and integrating a prototype modular command and control suite [ ] capable of meeting CINCSAC force management requirements for real-time intelligence fusion, battle management and force reconstitution. The new aircraft will be selected from existing production aircraft that meet the short, austere runway takeoff and landing capability and endurance requirements of the WWABNCP System Replacement Justification for Major System New Start (JMSNS). RDT&E funds procure and modify one prototype aircraft and command and control suite to be delivered to the Strategic Air Command in FY 1997 for an Initial Operational Capability. Production Decision is scheduled for FY 1997.

B. (U) **Program Accomplishments and Future Efforts:**

(1) (U) **FY 1986 Accomplishments:** Accomplished under PE 11312F. The Electronic Systems Division completed a system concept study for the WWABNCP Replacement. A Joint Resources Management Board (JRMB) Milestone 0 as a major system new start was approved by the Defense Resources Board in July 1986.

(2) (U) **FY 1987 Program:** Accomplished under PE 11312F. Efforts will be initiated to gain JRMB Milestone I in the second quarter of FY 1987. After Milestone I approval Requests for Proposals will be released for the Demonstration and Validation Phase. Two contractors will be selected for this phase. A second competition will be held for Full Scale Development Phase.

(3) **FY 1988 Planned Program and Basis for FY 1988 RDT&E Request:** The WWABNCP Replacement program will enter the Demonstration and Validation Phase, leading to a JRMB Milestone II in FY 1991. This phase will be focused

on three main areas: development of user unique software; identifing aircraft modification requirements; and developing specifications for integrating the command control (C^2) suite into the candidate aircraft. A majority of the FY 1988 efforts will concentrate on preliminary development of an extensive software package to demonstrate the real-time battle management capability needed to effectively manage survivable nuclear forces. Approximatey four million dollars will be transferred [ ] qualification of the C^2 suite. Groundwork for the aircraft selection in FY 1989 will begin. Cost estimates were developed by Electronic Systems Division estimates. An independent cost analysis will be completed in Feb 1987. Cost estimates (category IV, Planning) were reviewed in April 1986.

(4) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The Demonstration and Validation Phase for user unique software development and command and control (C2) suite integration will continue. Actual demonstration of the preliminary software will begin using the Defense Communications Agency test bed at the Strategic Air Command. The aircraft source selection process will be completed in FY 1989, and design of the selected aircraft modifications will begin. Classified efforts in C2 suite [ ] Approximately five million dollars will be transferred to the [ ] to be integrated into the aircraft during Full Scale Development. Cost category is IV, Planning.

(5) (U) Program to Completion: This is a continuing program. The WWABNCP Replacement program continues through full scale development and production, with the Initial Operational Capability scheduled for FY 1997. Production decision is scheduled for FY 1997, with first production aircraft scheduled for delivery in FY 1999.

C. (U) Major Milestones:

Milestones	Dates
(1) (U) Joint Requirements Management Board (JRMB) Milestone 0	July 1986
(2) (U) JRMB Milestone I	FY 1987
(3) (U) JRMB Milestone II	FY 1991
(4) (U) Initial Operational Capability	FY 1997
(5) (U) Production Decision	FY 1997
(6) (U) First Production Aircraft Delivery	FY 1999

9. (U) COOPERATIVE AGREEMENTS: Due to the sensitive nature of the nuclear command and control mission and associated development efforts, this program has been recommended for a waiver from cooperative agreements requirements.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64226F
DOD Mission Area: 113 - Airborne Strike

Title: B-1B
Budget Activity: 3 Strategic Programs

1. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		248,373	112,840	415,511	386,726	178,801*	3,972,500*
2731	B-1B BASELINE	248,373	112,840	375,672	219,792	0	3,530,760
3644	B-1B FORWARD LOOKING INFRARED SENSOR (FLIR) MODIFICATION	0	0	20,924	56,977	56,814	134,715
3645	B-1B ELECTRONIC COUNTER-MEASURES (ECM) MODIFICATION	0	0	18,915	109,957	0	128,872

* TOTALS REFLECT PROJECTS STARTING AFTER FY 1989

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The B-1B is a strategic, long-range, multirole weapon system which is able to perform the missions of conventional bomber, cruise missile launch platform, and nuclear weapons delivery system in both the tactical and strategic roles. Production of the B-1B addresses the national requirements to increase our targeting flexibility, to redress the relative decline of our strategic capabilities, and to revitalize our strategic deterrent forces. The B-1B significantly enhances the manned bomber portion of the strategic TRIAD while preserving the vitally needed flexibility for worldwide nonnuclear force projection in response to unforeseen contingencies. The program was mandated by Congress under Public Law 96-342 and fulfills Strategic Air Command Required Operational Capability 3-66 (Revised), New Strategic Manned Bomber, dated 22 November 1978, and the Long Range Combat Aircraft Mission Element Need Statement, dated 8 June 1981.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	271,640	118,652	28,948	N/A	13,816	3,070,536
Aircraft Procurement	5,094,900	0	0	N/A	0	24,114,791

Program Element: 64226F
DOD Mission Area: 113 - Airborne Strike

Title: B-1B
Budget Activity: 3 - Strategic Programs

(U) **EXPLANATION:** The FY 1986 RDT&E amount was reduced to provide Small Business Innovative Research Contributions and Gramm-Rudman-Hollings reductions. The FY 1988/FY 1989 B-1B Baseline RDT&E request has been increased to allow B-1B development and flight testing to be completed. Flight testing is being extended into FY 1989 to support additional effort needed for the flight control, terrain following and defensive systems, and cruise missile incorporation. Two new start modifications beyond the baseline are added. A forward looking infrared sensor is added for additional flexibility, and electronic countermeasures updates are made to keep up with the evolving threats. FY 1986 procurement was reduced for Gramm-Rudman-Hollings compliance.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Aircraft Procurement: (PE 11126F)						
Funds	4,793,941	0	0	0	0	23,696,800
Quantities	48	0	0	0	0	100
Military Construction*: (PE 11126F)						
Funds	200,620	50,000	3,600	9,160	1,190	366,210

*Military Construction funds are not part of the B-1B acquisition baseline.

5. (U) RELATED ACTIVITIES: The aircrew training devices and military construction for the B-1B are funded outside the B-1B baseline. These devices (five B-1B weapon system trainers, two mission trainers, six cockpit procedures trainers, and support equipment) will be developed under Program Element 64227F, Flight Simulator Development. The program will be managed by the Simulator Program Office at Wright-Patterson AFB, OH. Long range enhancements to the B-1B electronic countermeasures system are being developed in Progam Element 64738F.

6. (U) WORK PERFORMED BY: The B-1B program is in concurrent full scale development/production. It is managed by the B-1B System Program Office, Aeronautical Systems Division, Wright-Patterson AFB, OH. The B-1B System Program Office has overall integration responsibility for the development of the B-1B bomber. Rockwell International, North American Aircraft Operations, Los Angeles, CA, is the B-1B airframe manufacturer. Rockwell is responsible for achieving aircraft design integrity. Boeing Military Airplane Company, Seattle, WA, is the Avionics Subsystem Interface contractor responsible for integrating the B-1B avionics, and providing avionics equipment not furnished by the government. AIL

Division, Eaton Corporation, Deer Park, NY, develops and builds the B-1B defensive avionics system. General Electric Company, Aircraft Engine Group, Cincinnati, OH, is responsible for the design and development of the B-1B propulsion system. Several government agencies provide specialized assistance. For example: the facilities at Holloman AFB, NM, are used to measure radar cross-section characteristics; the wind tunnels at the Arnold Engineering Development Center, TN, are used for comparative analyses; and the Air Force Materials Laboratory and Air Force Avionics Laboratory at Wright-Patterson AFB, OH, are used in the development effort. The majority of the flight test will be done at the Air Force Flight Test Center, Edwards AFB, CA, but several other Department of Defense test ranges will also be used: White Sands Missile Range, NM; Eglin AFB, FL; Point Mugu Naval Air Station, CA; Utah Test and Training Range, UT; China Lake Naval Weapons Center, CA; Nellis Range Complex, NV; and others.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2731, B-1B Baseline:

A. (U) Project Description: The B-1B, a new long range combat aircraft, embodies current advances in aeronautical and countermeasures technologies required to enhance aircraft survivability in projected high threat environments. There is a continuing need for a long-range, large payload, flexible weapon system capable of worldwide rapid power projection.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: B-1B number nine entered the flight test program and began Common Strategic Rotary Launcher and cruise missile Testing. B-1B number ten successfully completed climatic testing. Delays were encountered in the development and testing of the flight control enhancements, terrain following system and defensive system. System immaturity resulted in some limits on the aircraft's initial capability, particularly in defensive avionics. However, Initial Operational Capability was successfully attained on schedule in September 1986. Air and ground crew training dominated the activity at Dyess AFB in FY 1986.

(2) (U) FY 1987 Program: The first B-1B was placed on continuous alert at Dyess AFB, TX, in October 1986. Crew training will continue to be the dominant use of assigned aircraft. Developmental problems with the flight control enhancements and terrain following system are expected to be resolved and the system will be certified for day-to-day training. Further flight control enhancements, defensive system and cruise missile testing will continue. Additional weapons certification will be accomplished. Due to the additional testing required, B-1A prototype number four was extended into the first quarter of FY 1987. B-1B number one will fly throughout FY 1987. Both were originally planned to complete testing in third quarter FY 1986.

Program Element: 64226F | Title: B-1B
DOD Mission Area: 113 - Airborne Strike | Budget Activity: 3 - Strategi_ Programs

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Development and testing efforts, originally planned to be completed before or during FY 1988, will be extended through FY 1988 and into FY 1989. B-1B number one will be extended at least through third quarter FY 1988, B-1B numbers nine and twenty-eight will be extended into FY 1989, and a new test aircraft (possibly number thirty-five) will be added to the test effort and used during FY 1988. The main focus of the FY 1988 development and test effort will be the defensive system, cruise missiles and the flight control enhancement needed to maximize the aircraft's altitude/gross weight potential. Cost estimate is category III, Budgetary.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The development and testing for cruise missile capability completes in FY 1989. B-1B numbers nine and twenty-eight complete flight test by second quarter FY 1989. Program Management Responsibility Transfer from Air Force Systems Command to Air Force Logistics Command occurs in FY 1989. Cost estimate is category III, Budgetary.

(5) (U) Program to Completion: Not Applicable

C. (U) Major Milestone:

		Milestones		Dates
(1)	(U)	Defense Systems Acquisition Review Council (DSARC) I		July 1967
(2)	(U)	DSARC II		July 1970
(3)	(U)	DSARC III		December 1976
(4)	(U)	B-1A Production Cancellation		July 1977
(5)	(U)	President Reagan's Strategic Modernization Program		October 1981
(6)	(U)	Full Scale Development Contract Award (Rockwell)		January 1982
(7)	(U)	Full Scale Development Contract Award (General Electric)		February 1982
(8)	(U)	Engineering Review		April 1982
(9)	(U)	Full Scale Development Contract Award (AIL and Boeing)		June 1982
(10)	(U)	Configuration Review		January 1983
(11)	(U)	B-1A number 2 Flight Test Start		March 1983
(12)	(U)	B-1A number 4 Flight Test Start		July 1984
(13)	(U)	B-1A number 2 Flight Test Terminated		August 1984
(14)	(U)	B-1A number 1 Flight Test Start		October 1984
(15)	(U)	B-1A number 4 Flight Test Complete	*(September 1986)	November 1986
(16)	(U)	B-1A number 1 Flight Test Complete	*(September 1986)	April 1988
(17)	(U)	B-1A number 9 Flight Test Start	*(March 1986)	April 1986

Program Element: 64226F
DOD Mission Area: 113 - Airborne Strike

Title: B-1B
Budget Activity: 3 - Strategic Program

(18)	(U)	Initial Operational Capability (15 aircraft)		September 1986
(19)	(U)	B-1B number 28 Flight Test Start	*(September 1986)	March 1987
(20)	(U)	B-1B number (xx) Flight Test Start	(Added)	January 1988
(21)	(U)	B-1B number 9 and 28 Flight Test Complete	*(September 1987)	February 1989
(22)	(U)	Full Operational Capability (100 aircraft)		June 1988
(23)	(U)	B-1B number (xx) Flight Test Complete	(Added)	September 1988

*Date presented in FY 1987 Descriptive Summary

9. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) PROJECT: 3644, B-1B Forward Looking Infrared (FLIR) Modification:

A. (U) Project Description: This FY 1988 new start modifies the B-1B fleet with a new capability, a FLIR sensor. The FLIR will provide the B-1B crew with a continuous wide field-of-view visual display to enhance overall situational awareness during low altitude maneuvering flight. The FLIR will increase the pilots field of regard to optimize terrain masking and permit nighttime aircraft landings at totally blacked out airfields.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Not Applicable.

(2) (U) FY 1987 Program: Not Applicable.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Feasibility and trade studies will be made to optimize use of existing aircraft controls and displays as well as available off-the-shelf equipment. Planning will be accomplished for trial installations and ground and flight tests. Cost estimate is category III, Budgetary.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Full scale development continues including flight test to finalize a production configuration and decision. Cost estimate is category III, Budgetary.

(5) (U) Program to Completion: Development continues through FY 1991 when installations are scheduled to begin.

C. (U) Major Milestones: Not Defined.

Program Element: 64226F
DOD Mission Area: 113 - Airborne Strike

Title: B-1B
Budget Activity: 3 Strategic Programs

10. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3645, B-1B Electronic Countermeasures (ECM) Modification:

A. (U) Project Description: This FY 1988 new start updates the B-1B defensive system beyond the baseline configuration in keeping with advances in the projected threat and intelligence refinements.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Not Applicable.

(2) (U) FY 1987 Accomplishments: Not Applicable.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The B-1B defensive system has by design, the flexibility to accept updates warrented by projected changes in threat conditions. This project will develop certain upgrades in response to changes in the threat enviornment which are occurring while the baseline system is being developed and produced.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Development of this phase of upgrade for the B-1B defensive system is completed in FY 1989.

(5) (U) Program to Completion: Not Applicable.

C. (U) Major Milestones: Not Defined.

11. (U) COOPERATIVE AGREEMENTS: Not Applicable.

Budget Activity: 3, Strategic Programs
Program Element: 64226F, B-1B

Test and Evaluation Data

1. (U) Development Test and Evaluation (DT&E): The Defense Systems Acquisition Review Council process was completed for the B-1A in December 1976. President Carter cancelled the production and deployment of the B-1A in June 1977.

(U) In July 1980, the United States Congress directed the Department of Defense to vigorously pursue the full scale engineering development of a multirole bomber with an initial operational capability no later than 1987. As a result of that direction, a Joint Air Force/Office of the Secretary of Defense Bomber Alternatives Study team evaluated advanced technology aircraft, the B-1 bomber aircraft and derivatives of the B-1 aircraft, and FB-111B/C aircraft.

(U) The General Electric Company was awarded an Initial Full Scale Development (IFSD) contract for a Long Range Range Combat Aircraft engine in February 1981. The engine was to be common to the aircraft alternatives being evaluated by the Joint Air Force/OSD Bomber Alternatives Study team. On 2 October 1981, President Reagan announced his decision to build 100 B-1Bs. Rockwell International Corporation, Boeing Military Airplane Company, and AIL Division of the Eaton Corporation were awarded their IFSD contracts in October 1981. Subsequent Full Scale Development (FSD) contracts were awarded to Rockwell in January 1982 and to General Electric in February 1982. Boeing and AIL received their FSD contracts in June 1982.

(U) The B-1B program is managed by the B-1B System Program Office. This program is a continuation of the original B-1A effort. Approximately 90 percent of the airframe testing planned for the B-1A was accomplished during the original 6 years of flight test. Further airframe and weapons testing and extensive defensive and offensive avionics testing were required. Examples of this testing include: examination of the improved AN/ALQ-161A defensive suite, integration of the new offensive avionics system, and an evaluation of the new terrain following radar and inertial navigation systems.

(U) The B-1B baseline test and evaluation program contains combined Development Test and Evaluation and Initial Operational Test and Evaluation flight testing which led to an Initial Operational Capability in September 1986.

(U) B-1A number 2, a fully instrumented prototype, was used for stability and control, vibration/acoustics, dynamic response, propulsion, flutter, and weapon carriage and separation tests. This aircraft began its portion of the B-1 flight test on 23 March 1983. On 29 August 1984, it crashed during a test flight. All unaccomplished tests from B-1A number 2 are incorporated into B-1B numbers 1, 9, and 28 flight test programs.

Budget Activity: 3, Strategic Programs
Program Element: 64226F, B-1B

(U) B-1A number 4, the last operational B-1A prototype, was the primary test vehicle for B-1B defensive and offensive avionics systems. It began its portion of the B-1B flight test program on 30 July 1984. This unique aircraft became non-supportable and was retired in early FY87.

(U) B-1B number 1 is being used to verify previous flutter, stability and control, performance, and weapons separation testing as well as new avionics testing. The aircraft flew its first sortie on 18 October 1984 and was originally planned to complete in July 1986. It will be extended to 1988 primarily to complete defensive avionics development.

(U) B-1B number 9 began its flight test effort in April 1986. Its planned testing includes the Stability Enhancement Function. B-1B number 9 is the first cruise missile capable B-1B. It will be used to conduct cruise missile carriage, separation, and launch tests. B-1B number 28 will also conduct cruise missile integration and flight control testing starting early in 1987. Both aircraft were scheduled to complete in mid FY88, but extensions to FY89 are required due to development delays in flight controls development.

(U) An unspecified B-1B will be added to the flight test program in FY88 to serve as a dedicated defensive system development asset.

(U) The majority of the flight tests will be done at the Air Force Flight Test Center, Edwards Air Force Base, California, but several other Department of Defense test ranges will also be used: White Sands Missile Range, New Mexico; Eglin Air Force Base, Florida; Point Mugu Naval Air Station, California; Utah Test and Training Range, Utah; China Lake Naval Test Center, California; Nellis Range Complex, Nevada; and others.

(U) The Reliability and Maintainability effort will be directed towards use of a stringent Parts Control Program, Reliability Development/Growth Testing, Burn-In Under Environmental Stress of all production lots, and Reliability Qualification/Production Reliability Tests for selected reliability of safety critical equipment.

(U) A Program Management Plan Executive Summary for the B-1B program has been submitted to the Deputy Secretary of Defense. The Strategic Air Command System Operational Concept was published in October 1982. A Decision Coordinating Paper, Integrated Program Summary, and Test and Evaluation Master Plan (TEMP), with associated schedules, milestones, cost estimates, and thresholds, were submitted to the Office of the Secretary of Defense (OSD) in November 1983. A revised TEMP was submitted to OSD in June 1984 and was provisionally approved. The latest TEMP update was forwarded to OSD in October 1985. The extensive restructuring of the B-1 T&E program, reflected in the above flight test extensions, will require further updates to the TEMP. A revised TEMP reflecting revised development and testing will be submitted to OSD by the third quarter of FY 1987.

Budget Activity: 3, Strategic Programs
Program Element: 64226F, B-1B

2. (U) Operational Test and Evaluation (OT&E): The Air Force Operational Test and Evaluation (AFOTEC) is assessing the operational effectiveness and suitability of the B-1B. Operational issues and OT&E test objectives have been identified by AFOTEC with the assistance of the Strategic Air Command, for the total OT&E program consisting of combined Development Test and Evaluation/Initial Operational Test and Evaluation (DT&E/IOT&E) and Follow-on Test and Evaluation (FOT&E). Those OT&E objectives not sufficiently addressed during the combined DT&E/IOT&E will be addressed during FOT&E. Successful accomplishment of the IOT&E portion of the B-1B OT&E plan has thus far been prevented by the delayed development and maturation of the B-1B systems. Late delivery of support equipment, ground readiness tests, and verified T.O.s limited the operational evaluation during the combined DT&E/IOT&E.

(U) Combined DT&E/IOT&E flight testing began with the initial flight of B-1A number 2 on 23 March 1983, and flight test will continue through April 1988. B-1A number 4 and B-1B numbers, 1, 9, and 28 will also be used in the combined test program. B-1A number 2 was lost in August 1984, and B-1B number 28 has been included to supplement cruise missile testing. The OT&E evaluation will use all applicable B-1A test data to evaluate the B-1B. Operational suitability testing began during combined DT&E/IOT&E and will extend into FOT&E, since some support equipment will not be delivered until late in the combined DT&E/IOT&E test program.

(U) The areas of special interest in B-1B OT&E testing are survivability, navigation reliability and accuracy, low level penetration capability, weapons delivery, mission reliability, and diagnostic capability.

(U) Much of the data from the B-1A DT&E/IOT&E flight test are directly transferrable to the B-1B and will not have to be reevaluated. However, some deficiencies identified in the B-1A DT&E/IOT&E have been corrected in the B-1B and will be reexamined: horizontal stabilizer hinge moment, engine nozzle design, pitch trim rate, flap/slat system, engine start system, flight control nonlinear gearing, overwing fairings, inertial navigation system, weapon bay door acoustics and vibration, central intergrated test system, and fuel leaks.

(U) The Program Management Directive and the Test and Evaluation Master Plan specify the OT&E responsibilities of Air Force Operational Test and Evaluation Center (AFOTEC), Strategic Air Command, Air Force Logistics Command, Air Force Systems Command, and Air Training Command.

(U) Successful accomplishment of the IOT&E portion of the B-1B OT&E test plan has thus far been prevented by the delayed development and maturation of the B-1B systems. Because of late deliveries and development work yet to be accomplished, the majority of OT&E remains to be accomplished.

(U) Operational Test and Evaluation Reports Published:

(1) (U) HQ AFOTEC, B-1A IOT&E Final Report, March 1977 (Secret).

Budget Activity: 3, Strategic Programs
Program Element: 64226F, B-1B

(2) (U) HQ AFOTEC, Manned Bomber Penetration Evaluation Final Report, 30 June 1981 (Secret).

(3) (U) HQ AFOTEC, Pre-IOC Report (Interim Assessement), August 1986 (Secret).

3. (U) Systems Characteristics: The B-1B contract specifications have been negotiated. The following required system parameters will be demonstrated during the combined DT&E/IOT&E flight test program now planned to end in 1988. This list represents the test objectives for initial operational capability after the aircraft have been flown for approximately 2,500 flying hours, and the characteristics demonstrated as of 1 October 1986.

Characteristics	Objectives/Thresholds	Demonstrated
(U) Technical:		
(U) Weight empty (pounds)	186,000	181,400
(U) Operational:		
(U) Takeoff distance (feet) (Sea level, standard day, 20 degree wing sweep)		
( ) 440,000 pound aircraft	[ ]	1/
( ) 470,000 pound aircraft	[ ]	1/
(U) Sustained speed (Mach number)		
( ) Best cruise at altitude	[	]
( ) Penetration		
(Intermediate power, sea level, standard day)		
Penetration Mission Range 2/ (Nautical miles [nm])	[	]
(U) Payload (Number of weapons)		
(U) AGM-69A (Int)	24	16 3/
(U) AGM-86B (Int/ext) 4/	8/12	5/
(U) MK-82(AIR)/MK-36DST(AIR) (Int)	84	6/
(U) B61/B83 (Int)	24	24

375 347 315

Budget Activity: 3, Strategic Programs
Program Element: 64226F, B-1B

Characteristic	Objectives/Thresholds	Demonstrated
(U) Readiness/Supportability		
(U) Technical:		
(U) Built-in Test False Alarm Rate	5%	40.3%
(U) Central Integrated Test System Fault Detection Rate	0.90	Data Being Collected
(U) (Operational)		
Availability (B-1B System)	[ ]	Data Being Collected
(U) Maintainability (Maintenance Manhours/Flight Hour)(B-1B System)	80	46.9
(U) Meantime Between Unscheduled Maintenance Actions (B-1B System)	0.22	.32
Mission Completion Success Probably. 7/	[	]

1/ (U) These higher weights cannot be demonstrated without cruise missile carriage. Heavy gross weight flight testing is on hold pending cruise missile heavyweight buildup. Cruise missile capability date is September 1988.

2/ ( ) [ ]

3/ (U) SRAM is not certified for use from aft bay pending resolution of pitchdown phenomenon during separation. All certification is complete on forward and mid bays.

Budget Activity: 3, Strategic Programs
Program Element: 64226F, B-1B

4/ (U) The cruise missile test objectives/thresholds are to be demonstrated by the cruise missile weapons capability date which is September 1988.

5/ (U) Cruise missile carriage demonstration is limited to 20 total in keeping with arms control policy. Cruise missile capability date is September 1988.

6/ (U) Conventional testing delayed to support priority certification of nuclear weapons prior to IOC.

7/ (U) Mission Completion Success Probability is a measure of system reliability as it affects the mission, but excludes factors such as probability of kill, circular error probable, and electronic warfare.

4. (U) Current Test and Evaluation (T&E): IOT&E: The test team is evaluating flight software to include terrain following, weapon release, and navigation. The defensive system and Central Integrated Test System are still in development. All capabilities delivered to date have had OT&E involvement in the testing performed. FOT&E: A suitability evaluation is being conducted that will continue through the end of the program. Dedicated FOT&E effectiveness sorties will start 1 October 1986 and run through March 1989.

T&E Activity (Past 12 Months)

Event	Planned Activity	Actual Date	Remarks
Combined DT&E/IOT&E Flights (U)	January - December 1986	January - December 1986	Edwards AFB, CA B-1A #4, Avionics testbed B-1B #1 Flight performance B-1B #9 Air Launched Cruise Missile testing B-1B #10 Climatic testing
FOT&E (U)	January - December 1986	January - December 1986	Dyess AFB, TX B-1B Suitability and Operational Effectiveness

T&E Activity (Next 12 Months)

Event	Planned Date	Remarks
Combined DT&E/IOT&E Flights (U)	January - December 1987	Edwards AFB, CA. B-1B #1 Flight performance B-1B #9/28 Air Launched Cruise Missile testing
FOT&E (U)	January - December 1987	Dyess AFB, TX B-1B Suitability and Operational Effectiveness

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64234F
DOD Mission Area: 113 - Airborne Strike

Title: Common Strategic Rotary Launcher (CSRL)
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		48,411	13,120	5,715	947	0	271,486

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: A need exists within the Strategic Air Command to develop and deploy a Common Strategic Rotary Launcher (CSRL) for the B-52H, B-1B and the Advanced Technology Bomber (ATB). The need is for a multipurpose launcher that can accommodate current and future gravity weapons, Short Range Attack Missiles (SRAM), cruise missiles and Advanced Cruise Missiles (ACM). The CSRL will be designed to carry a combination of these weapons on the same launcher load. Initially the CSRL will be integrated into the B-52H to carry homogeneous loads of gravity weapons, SRAM and Air Launched Cruise Missiles (AGM-86B). As the B-52H retires the same CSRLs will transfer along with a conversion kit to the B-1B. The CSRL will be integrated into the ATB with full mixed carriage capability of ATB baselined weapons.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	70,778	14,591	5,832	N/A	977	300,200
Aircraft Procurement	70,900	100,000	101,300	N/A	174,400	446,600

EXPLANATION: (U) The RDT&E reductions reflect both Congressional reductions and reprogramming actions. The procurement reductions totaled $88.5 million. The $16.2 million Congressional reduction in FY1987, the $28.1 million DOD reduction in FY1988, and the $44.8 million DOD reduction in the outyears were all based upon cost savings realized during contract negotiations.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

Aircraft Procurement (PE 11113F):						
Funds	70,900	83,800	73,200	56,300	73,900	358,100
Quantities GpA/GpB	3/5	23/26	22/23	23/24	25/26	
Missile Procurement (PE 11122F):						
Funds	0	6,165	4,732	3,683	2,663	18,543
Quantities	0	26	23	24	26	

5. (U) RELATED ACTIVITIES: Common Strategic Rotary Launcher (CSRL) has transitioned from Advanced Development (PE 63258F) to Engineering Development (PE 64234F). The Air Launched Cruise Missile (ALCM) program (PE 11122F) provides for the modification/procurement of certain items of ALCM unique support equipment. Specific items include suspended loading checkout frames, CSRL attachment adapters, ALCM ejector alignment fixtures, launcher loader adapters, and electronic system test package sets.

6. (U) WORK PERFORMED BY: The Boeing Military Airplane Company (BMAC), Wichita, Kansas, is the prime contractor and was awarded a contract in June 1983 for launcher full scale development. The development program was awarded to BMAC subsequent to a competitive development effort. Boeing and Rockwell, El Segundo, California, are the respective contractors for integrating the launcher into the B-52H and the B-1B. The Air Force developing organization is the Aeronautical Systems Division of Air Force Systems Command, Wright-Patterson Air Force Base, Ohio.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 64234F, Common Strategic Rotary Launcher

A. (U) Project Description: The Common Strategic Rotary Launcher (CSRL) is a multipurpose internal rotary munitions launcher for the B-52H, B-1B and the Advanced Technology Bomber (ATB). The primary purpose of CSRL is to allow the B-52H to carry internal cruise missiles. It will also carry current and future nuclear gravity weapons and Short Range Attack Missiles (SRAM). The CSRL will carry homogeneous loads of these weapons on the B-52H. CSRL is designed to carry a combination of baselined weapons, as well as future conventional weapons, on the same launcher load for advanced bomber applications. As the B-52H retires, the same CSRLs will transfer to the B-1B with a conversion kit. The CSRL improves readiness because it increases munitions delivery flexibility, reduces logistics support structure and provides growth potential for future munitions. The CSRL has also been proven to be the least cost alternative that satisfies the user's requirements. The CSRL program element funds development of the launcher and integration into the B-52H. The B-1B and the ATB each fund their own launcher integration programs. A roadmap study determined that a common launcher design could be adapted for use on all three bombers. Along with the reduction to a single common launcher design, support equipment was also consolidated so that the Air Force would realize maximum commonality and life cycle cost benefits.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: The B-52 flight test completed in January 1986 and the B-1B flight test began in May 1986. The B-52 field and depot support equipment completed development, while the development of B-1B field and depot support equipment continued. This program element funds only technical support for the B-1B flight test. Development and testing of modified B-52 software was completed in August 1986. FY 1986 Low Rate Initial Production contract was awarded to Boeing Military Airplane Company.

(2) (U) FY 1987 Program: Full rate production of the modified aircraft and the launcher begins. The request corrects B-52 hardware and software deficiencies identified during flight testing. The physical configuration audit on the first B-52 production article will be accomplished. Nuclear certification on the B-52 CSRL will be initiated. The flight test program will continue for the B-1B. Development of B-1B field and depot support equipment will terminate.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: FY 1988 development efforts will deal with B-1B/CSRL flight testing scheduled to be completed in March 1988. Provide contractor support for B-1B/CSRL flight test and nuclear certification efforts. A parametric estimate based on negotiated prices was used to prepare the request. Cost estimating category is IIB.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: FY 1989 is the final year of RDT&E for the CSRL. Completes nuclear certification efforts and corrects deficiencies identified in B-1B/CSRL flight test. The final year of RDT&E slipped from FY 1987 to FY 1989 due to the crash of B-1A #2, which was the programmed test aircraft.

(5) (U) Program to Completion: Not Applicable

C. (U) Major Milestones:

Milestones	Dates
(1) (U) Full Scale Development (FSD) Contract Award	June 1983
(2) (U) Preliminary Design Review	September 1983
(3) (U) Critical Design Review	March 1984
(4) (U) First FSD Unit Fabrication	July 1984
(5) (U) Start B-52 Flight Test	August 1985
(6) (U) Complete B-52H/CSRL Flight Test	January 1986
(7) (U) Start B-1B Flight Test	May 1986
(8) (U) B-52H Initial Operational Capability	March 1990

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: #64312F
DOD Mission Area: #111 - Land-Based Strike

Title: Intercontinental Ballistic Missile (ICBM) Modernization
Budget Activity: #3 - Strategic Programs

1. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT*	1,302,224	1,547,407	2,875,728	3,461,672	TBD	TBD

*Includes resources in the following categories (Totals may not add due to rounding):

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Peacekeeper (MM silo Deployment)	668,775	290,000	51,191	39,979	35,205	6,480,749
Small ICBM	581,205	1,137,407	2,233,181	2,228,791	4,682,633	11,650,017
Alternative Basing Technology	52,244	120,000	591,356	1,192,902	TBD	TBD

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The military need for ICBM modernization stems from the requirement to respond to Soviet ICBM developments which are causing a major imbalance between the United States and Soviet strategic capabilities. The overall mission of the ICBM modernization program is to support the U.S. strategic deterrent policy while responding to changes in the projected Soviet threat and target base. The modernization program is built on the recognition that all ICBM tasks cannot be served by a single basing mode. The near-term response --deploying 50 Peacekeeper in Minuteman silos--will reduce the Soviet advantage in ICBM capability and help deter a broad spectrum of potential threats including massive conventional or limited nuclear attacks on the United States or our allies. The long-term response includes deploying Peacekeeper missiles in a more survivable basing mode, and deploying a small single-warhead ICBM in Hard Mobile Launchers (HMLs) in two basing configurations. Both programs emphasize missile mobility to enhance survivability.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
RDT&E	1,442,271	2,116,789	2,733,726	N/A	TBD	TBD
Missile Procurement	1,776,800	1,473,500	2,142,700	N/A	4,035,000	14,076,300
Aircraft Procurement	35,000	33,200	26,200	N/A	0	101,100

EXPLANATION: (U)

RDT&E: Decrease in FY 1986 is due to Gramm-Rudman and undistributed reductions. Decrease in FY 1987 is due to Congressional reduction of FY 87 President's Budget and Congressionally directed undistributed reduction. Net increase in FY 88 is due to Alternative Basing request to develop the Rail Garrison basing mode.

Missile Procurement: FY 1986 funding was reduced by Congress. FY 1987 funds reflect Congressional reduction from 21 to 12 missiles and Congressionally directed undistributed reduction. FY 1988 funds reflect a request for 21 missiles, a reduction from 48.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

Program Element 11215F (Peacekeeper Squadrons)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total
Aircraft Procurement (Airborne Launch Control Center Mod Kits)						
Funds	31,900	25,600	19,900	0	0	84,200
Quantities	7	8	6	0	0	22
Other Procurement (Flight/Ground Test Support)						
Funds	1,464	147	349	284	253	6,591
Missile Procurement						
Funds	1,152,099	1,136,599	1,276,884	1,361,085	4,705,465	14,176,132
Quantities	12	12	21	21	115	223
Military Construction:						
Funds	53,058	25,900	9,400	51,000*	TBD	TBD

*Contains $44.5 million for construction necessary to test the Rail Garrison concept at F.E. Warren AFB.

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Program Element 11219F (Small ICBM Squadrons)						
Missile Procurement						
Funds	0	0	0	121,600	30,555,920	30,677,520
Quantities					623	623
Military Construction						
Funds	0	0	0	0	2,400,600	2,400,600

5. (U) RELATED ACTIVITIES: This program is directly related to efforts in the programs for Peacekeeper Squadrons (PE 11215F), Small ICBM Squadrons (PE 11219F), and Advanced Strategic Missile Systems (PE 63311F). This program and the related programs are all managed within the Ballistic Missile Office, thus assuring close coordination. PE 11215F contains funding for both Peacekeeper military construction and missile procurement. PE 11219F contains funding for Small ICBM military construction and missile procurement.

6. (U) WORK PERFORMED BY: The program is managed by the Ballistic Missile Office, Norton Air Force Base, CA. Facilities at Arnold Engineering Development Center, Tullahoma, TN, are used for motor testing and facilities at the Central Inertial Guidance Test Facility at Holloman AFB, NM are used for guidance testing. Flight testing is conducted at Vandenberg AFB, CA. The top five ICBM Modernization Program contractors are Martin Marietta Aerospace, Denver, CO (Assembly, Test and Systems Support; Peacekeeper Support Equipment); Boeing Aerospace, CO Seattle, WA (Basing Operational Support, Hard Mobile Launcher); Rockwell International Rocketdyne Division, Canoga Park, CA (Guidance and Control); Northrop Electronics Division, Hawthorne, CA (Inertial Measurement Unit); and AVCO, Wilmington, MA (Reentry Vehicle/Reentry System). The total dollar value of current R&D contracts is $6,900,000,000.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not applicable.

8. (U) PPOJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 64312F, ICBM Modernization

A. (U) Project Description: In October 1981, the President initiated the U.S. Strategic Modernization Program to counter growing Soviet threats to U.S. strategic systems. Congress subsequently directed further study of survivable ICBM basing concepts in the FY 1983 Continuing Resolution. In response, the President formed the Commission on Strategic Forces (Scowcroft Commission) to review strategic force modernization with special focus on ICBM systems. In April 1983, the Commission submitted its recommendations, which were endorsed by the President and later approved by the Congress. The following describes the three elements of the resultant ICBM Modernization Program. Peacekeeper. The Peacekeeper missile system entered full-scale development in September 1979. Current major areas of effort include

production of missile and basing subsystems, system integration and extensive testing to support the production design. The missile subsystems include an advanced guidance set derived from the Advanced Inertial Reference Sphere (AIRS) prototype. The three solid propellant boosters use a lightweight motor case. For increased system performance, stages two and three have advanced nozzles and stage three uses a high energy propellant. The Peacekeeper reentry vehicle (RV) is the Mark-21. Basing development includes modification of the existing Minuteman silo design and launch control system and development of ground support transportation/handling equipment. Related military construction efforts include modification or construction involving facilities at Vandenberg AFB, CA, (PE 64312F) to support missile flight testing; facilities at F.E. Warren AFB, WY, (PE 11215F) for deployment and operation of the system in 50 Minuteman silos at the 400th Strategic Missile Squadron; facilities at Hill AFB, UT, to enable logistics support of the system, and facilities supporting the airborne launch control operations at Ellsworth AFB, SD, and Offutt AFB, NE. Small ICBM. The underlying logic for this recommendation of the Scowcroft Commission was that a Small ICBM could provide long-term survivability and, with a single reentry vehicle, would present a relatively low-value target. Properly based, a Small ICBM could be stabilizing and would enhance the arms control process. The President and the Congress concurred with this recommendation, and the Office of the Secretary of Defense directed the Air Force to vigorously pursue the development of the Small ICBM. In response, the Air Force established a Deputy for Small ICBM at the Ballistic Missile Office (BMO) to be responsible for the development and acquisition of the Small ICBM and basing technology. The Air Force also convened the Small Missile Independent Advisory Group (Schriever Group) to recommend an acquisition strategy and management approach for the program. The Air Force has implemented the Schriever Group's recommendations and is currently in the full scale development program phase. The "baseline" Small ICBM weapon system builds on Peacekeeper technology. The missile will weigh approximately 37,000 pounds and have a range of over 6,000 nautical miles. It will be cold-launched, consist of three solid propellant stages and be augmented with a liquid postboost deployment system. The basing mode is a hard mobile launcher initially deployed on Minuteman launch facilities with the future option for additional deployments in a random movement scheme. On 19 December 1986, the President directed that the Small ICBM be placed into full scale develoment leading to an initial operating capability (IOC) of 1992. The first deployment is planned at Minuteman Launch Facilities at Malmstrom AFB, Montana with deployments at F.E. Warren AFB, WY and Ellsworth AFB, SD as possible follow-on locations. In addition, random area deployment basing of HMLs at large DOD reservations in New Mexico and Arizona is under consideration. Alternative Basing Technology. As recognized by the Congress, the development of technology applicable to the future U.S. ICBM force could provide greater diversification and survivability. Over the last eighteen months, the Department of Defense has conducted an extensive study on the potential advanced basing technologies hold for future ICBM deployments. The result of this study was the President's decision, in December 1986, to begin development of Rail Garrison as a future basing mode for Peacekeeper missiles.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Peacekeeper. The program continued to wind down full-scale development using a combination of competition and sole source contracting. There were five RDT&E flight tests in FY 1986, all successful. The development test laboratories at Vandenberg AFB and Seattle continued developing and validating various electrical and software elements required for Peacekeeper. The FY 1986 Military Construction Program, totaling [illegible].8 million, consisted of one project each at Ellsworth, Hill, and Offutt AFBs and three projects at F.E. Warren AFB.

Small ICBM. Propulsion contractors conducted burst tests and full scale test firings of actual SICBM stage designs including appropriate simulated altitude firing of each stage design. An underground nuclear test of the Laser Fiber Optic ordnance system was conducted and a single ordnance system was selected in 1986. Successful mobility tests of full scale non-operational hard mobile Launcher (HML) Mobility Test Vehicles were concluded. Airblast shock tube tests were conducted. Sled tests of Advanced Inertial Navigation Systems (AINS) were successfully conducted, as well as an underground nuclear test of Guidance and Control (G&C) components. Interim Design Reviews for the G&C systems were held in March 1986. Alternative Basing Technology. Hard Silo subsystem and component design and testing continued. Tests of the Shock Isolation Subsystem (SIS), vertical and lateral, were conducted, completing the SIS validation program. In addition, subsystem tests were conducted on silo penetration concepts, validating optimal design solutions. A sixth deep basing contract was initiated in FY 1986. The contract included a subscale demonstration of the flyout launch concept. This work and the program in FY 1985 partially completed pre-prototype design and planning for demonstration testing. Eight basing modes were studied for possible selection as a follow-on ICBM basing mode, especially for Peacekeeper basing. These included Shallow Tunnel, Carry Hard, Superhard Silo with and without concealment, Rail Garrison, Hardened Minuteman Ground Mobile and Deep Basing.

(2) (U) FY 1987 Program: Peacekeeper. Flight test fifteen was successfully conducted in December 1986. The final five of twenty scheduled RDT&E flight tests are planned for the remaining portion of FY 1987. Initial Operational Capability (IOC) was achieved in December 1986 with the deployment of 10 missiles at the 400th Strategic Missile Squadron. The remaining 40 missiles will be deployed in silos during calendar years 1987-88. The Program Office will continue development of a second source for the Guidance System Inertial Measurement Unit (IMU) for possible future competition. The FY 1987 Military Construction Program (MCP) consists of the two projects at Hill AFB and four projects at F.E. Warren AFB. Depot support will be activated at Warren, Hill and Kelly AFB. Automatic Test Equipment will be delivered to Newark AFS, OH to support the guidance system. Small ICBM. FSD began in FY 1987. In December 1986, FSD contracts for propulsion and the Hard Mobile Launcher were awarded. Flight Tests of competing Advanced Inertial Reference Sphere (AIRS) on Peacekeeper missiles and Alternate Inertial Navigation System (AINS) on Minuteman III missiles will be conducted. Weapon system nuclear hardness and survivability tests and analyses will also be worked Continued development of the missile stages by FSD winning contractors, including static firings, will commence to support a first flight in FY 1989. The Weapon Control System (WCS) will select a single contractor; hardware and software will be designed in detail. The Hard Mobile Launcher contractor will continue mobility and hardness studies and initiate FSD design. Alternative Basing Technology. In October 1986, the President approved a downselect to four candidate basing modes for follow-on ICBM development. After further study on the remaining four modes, the President decided, in December 1986, to begin development on Rail Garrison as a future Peacekeeper basing mode. FY 1987 work will include system concept development, system requirement analysis and concept test and evaluation. Research continues on deep basing.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Peacekeeper. The RDT&E projection includes final flight test report data reduction/analysis and support for Strategic Air Command Follow-on Test and Evaluation flights. This allows the Air Force to remain postured to accommodate any changes identified during deployment. Procurement of 21 missiles is planned. The FY 1988 Military Construction Program will include two projects at

Hill AFB. Designs are 35 percent complete for the projects. Small ICBM. FSD will continue through FY 1988 with Preliminary Design Reviews held for the missile, Hard Mobile Launcher and the Weapon Control System. The first, inert Small ICBM will be delivered to Vandenberg AFB, CA, for electrical and mechanical checkout. In addition, fabrication will begin on the Hard Mobile Launcher. Final downselect between AIRS and AINS will occur. Alternative Basing Technology. Continued development of the Rail Garrison concept will provide the foundation for a future decision to deploy Peacekeeper missiles in a Rail Garrison basing mode. Areas of development will include test planning and technology validation. Development will also encompass integration of software and hardware, especially for the launch control system and guidance and control system. System design reviews and preliminary design reviews will be conducted on subsystems such as individual rail cars and the launch cannister. Environmental impact analysis is also slated for FY 1988.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Peacekeeper. Deployment of the 50th Peacekeeper in Minuteman silos is scheduled for December 1988. RDT&E is required to accommodate any changes identified in completing the test program and during deployment. Specific RDT&E requirements include nuclear hardness testing and engineering support. Military construction necessary to test the Rail Garrison concept at F.E. Warren AFB will begin in FY 89. SICBM. Design reviews on critical components will be completed, including the missile, HML and weapons control system. Flight tests from a cannister on a concrete pad will continue in preparation for a production contract award in the next fiscal year. Alternative Basing Technology. Development of Rail Garrison continues, to include prototyping of subsystems and preliminary design reviews.

(5) (U) Program to Completion: Peacekeeper. Missile production is projected to continue through the FYDP. Small ICBM. The first system flight test from an HML is planned for the second quarter of 1990. IOC is in 1992. Alternative Basing Technology. Development will continue on Rail Garrison with the goal of presenting Congress with an option to deploy Peacekeeper missiles in a more survivable basing mode.

C. (U) Major Milestones:

Peacekeeper Milestones	Dates
(1) (U) Strategic Air Command Required Operational Capability 16-71, Advanced ICBM System	February 1972
(2) (U) Defense Systems Acquisition Review Council I	March 1976
(3) (U) Validation Phase Initiated	October 1976
(4) (U) Defense Systems Acquisition Review Council IIB	July 1979
(5) (U) Full-Scale Development Initiated	September 1979
(6) (U) System Design Review	September 1980
(7) (U) President's Strategic Modernization Program Announced	October 1981
(8) (U) Scowcroft Commission Recommendation/Presidential Decision	April 1983
(9) (U) First Flight Test	June 1983
(10) (U) Nuclear Hardness and Survivability Review Group Convened	October 1983
(11) (U) Production Start	January 1984

(12)	(U) First Silo Launch		August 1985
(13)	(U) Initial Operational Capability		December 1986
(14)	(U) Deployment Completed for 50 missiles		4th Qtr CY 1988

	Small ICBM and Hard Mobile Basing Milestones		Dates
(1)	(U) Scowcroft Commission Recommendation		April 1983
(2)	(U) Small ICBM Program Office Established		May 1983
(3)	(U) Schriever Group Recommendation		September 1983
(4)	(U) Nuclear Hardness and Survivability Review Group Initiated		October 1983
(5)	(U) Pre-Full-Scale Development Start		October 1984
(6)	(U) Full-Scale Development Start		December 1986
(7)	(U) System Design Review		1 Qtr CY 1987
(8)	(U) First Flight Test		1 Qtr CY 1989
(9)	(U) Production Start		4 Qtr CY 1989
(10)	(U) Initial Operational Capability		December 1992

	Alternate Basing Technologies Milestones		Dates
(1)	(U) Initial Nuclear Environment Definition		Mid-1983
(2)	(U) Initial Concept Phase for Deep Basing Completed		September 1983
(3)	(U) Nuclear Hardness and Survivability Review Group Convened		October 1983
(4)	(U) OSD Deep Basing Requirements Study Completion		March 1984
(5)	(U) First Egress Subsystem Demonstration for Hard Silo		February 1985
(6)	(U) Follow-on Basing Decision	* (New)	December 1986

* New entry see below

(U) Explanation of Milestone Changes

(6) (U) The President has directed that development begin on Rail Garrison as a future mode for basing Peacekeeper missiles.

9. (U) COOPERATIVE AGREEMENTS: Not applicable.

Budget Activity: 3, Strategic Programs
Program Element: 64312F, Peacekeeper

Test and Evaluation Data

1. (U) Development Test and Evaluation (DT&E): The Ballistic Missile Office (BMO), Norton AFB, CA, is the Air Force Program Manager for developing the Peacekeeper Weapon System. BMO is also the Responsible Test Organization for DT&E. The Air Force Operational Test and Evaluation Center is responsible for initial operational test and evaluation (OT&E). The Strategic Air Command will operate Peacekeeper and will, jointly, with the Air Force Logistics Command be responsible for maintaining the system. Principal development contractors are: Aerojet General Corporation, Avco Systems Division, General Electric Company, Goodyear Aerospace Corporation, GTE Sylvania, Hercules Aerospace Corporation, Honeywell Incorporated, Logicon Incorporated, Martin Marietta Corporation, Morton-Thiokol Incorporated, Northrop Corporation, Rockwell International - Autonetics Division, Rockwell International - Rocketdyne, TRW, The Boeing Company, Westinghouse Electric Corporation.

(U) The Peacekeeper in Minuteman Silos DT&E program to date has concentrated primarily on the development and test of missile subsystems, reentry vehicle development, and silo integration, with fifteen successful flight tests. Flight testing from a modified Minuteman launch facility, as prescribed in the program basing system concept, has begun. DT&E testing reported herein summarizes activity of the first fifteen flight tests of Peacekeeper flight test missiles (FTM) and the significant basing hardware and software system tests.

(U) A total of 20 test flights from the Western Test Range at Vandenberg AFB (VAFB), CA, have been scheduled. Flight tests will continue after deployment with 108 follow-on operational test and evaluation flights conducted by the Strategic Air Command. The flight test articles will be configured with instrumented reentry vehicles and an instrumentation and flight safety system. The test and evaluation objectives are to evaluate missile performance including Peacekeeper stage II and III motor extendible nozzle exit cone capability to survive and perform during actual Peacekeeper missile powered flight; and to assess the capability of the advanced inertial reference sphere guidance and control units to achieve accuracy and reliability, including ground system operational interface, stage performance, guidance and control accuracy, post boost vehicle footprint, and time of flight performance capabilities. The first eight launches were from a test pad to evaluate the missile. The last twelve launches will be from modified Minuteman launch facilities. The ninth launch was the first conducted from a modified Minuteman silo using operational ground and flight programs, while being controlled from a Minuteman launch control facility. Major emphasis focused on the integration testing of ground support systems, with continued emphasis on missile subsystems. Future flight tests will focus increasingly on weapon system performance and operational system verification. To date, there have been fifteen successful flight tests and the sixteenth flight test missile is in assembly and checkout at VAFB.

(U) The test data thus far has provided confidence that the required weapon system performance can be met within the identified state-of-the-art technologies at a reasonable cost. Additionally, this testing has provided hardware

design data which will assure more comprehensive specifications and a more realistic estimate of life cycle system costs. The test program initially evaluated areas of design risk in guidance, motor and nozzle, reentry system, launcher, command control and communication, ground power, physical security system, and nuclear hardness and survivability. Contractor test facilities, Arnold Engineering Development Center, Tullahoma, TN; Rocket Propulsion Lab, Edwards Air Force Base, CA; Nevada Test Site, Mercury, NV; Holloman Air Force Base, NM; Kirtland Air Force Base, NM; Hill Engineering Test Facility (HETF), Hill Air Force Base, UT; Hunters Point Naval Station, CA; and Vandenberg AFB, CA, have been used for most of the testing to date.

DT&E on guidance and control (G&C) during full-scale development (FSD) is currently emphasizing performance (functional and accuracy) testing of missile subsystems in a benign flight environment. All airborne vehicle and ground support equipment was tested, prior to flight, during the pathfinder testing at Vandenberg Air Force Base, (VAFB). Ground testing culminated in an end-to-end polarity test of the missile system. Flight missile guidance and control sets (MGCS) for the FTM-1 through FTM-15 tests completed acceptance testing at the contractor and were delivered to VAFB where they successfully completed pre-launch and flight test. Data analysis indicates excellent performance by fourteen of the fifteen guidance systems. The mean point of impact (down, cross) for each of the first fourteen flight tests are as follows: [ ] Mean point of impact data for flight 15 is not yet available. The test range accuracy is [ ]

(U) Guidance and control tests completed to date include vibration, shock, temperature, attitude, electromagnetic compatibility, TEMPEST, and integration testing. Tests required to identify potential improvements for the MGCS operational mechanization were completed in FY 1984.

(U) FY 1985 and FY 1986 full scale development testing activities included flight tests, qualification tests, and interface tests. The launch control system controller with its new controlling software, the interfaces with a new programmer group at the launch facility, and modified software at the launch control facility were integrated for the first time on FTM-9. Flight testing of the guidance system using operational ground and flight computer programs began with FTM-9 and continues on subsequent flights. New routines for calibration and alignment will also be tested during this portion of the flight test program. The mechanization and accuracy of these new routines have been verified during sled test environmental runs performed at Holloman AFB in FY 1984 and early FY 1985. Additional sled test runs were accomplished in late FY 1985 to demonstrate the mechanization and accuracy capabilities of the actual flight computer programs. Activities to reduce the time required for the calibration and alignment sequence will continue in FY 1986. Radiation and mechanical qualification tests will be performed on the missile electronics and computer assembly (MECA), the inertial measurement unit and the MGCS. G&C subsystem interface testing with basing equipment began in FY 1985 and continues into FY 1986. Preliminary tests will be performed at contractor facilities with final checkout to be accomplished at Vandenberg and Francis E. Warren AFBs.

Budget Activity: 3, Strategic Programs
Program Element: 64312F, Peacekeeper

(U) Stage I is a solid propellant rocket motor that is 28 feet long, 92 inches diameter, and weighs approximately 107,000 pounds. It has a thrust vector actuation system that can vector the nozzle up to six degrees. Stage I boosts the missile to about 75,000 feet following cold launch from the canister.

(U) Stage II is a solid propellant rocket motor that is 18 feet long, 92 inches diameter, and weighs approximately 60,000 pounds. It has a thrust vector actuation system that can vector the nozzle up to six degrees, and an extendible nozzle exit cone (ENEC) that is deployed after stage ignition to increase performance at operating altitudes. Stage II boosts the missile from approximately 75,000 to 300,000 feet.

(U) Stage III is a solid propellant rocket motor that is 90 inches long, 92 inches diameter, and weighs approximately 17,000 pounds. It has a thrust vector actuation system that can vector the nozzle up to three degrees, and an ENEC that is deployed after stage ignition to increase performance at operating altitudes.

(U) Stage IV is a liquid propellant stage with one axial rocket engine and eight attitude control thrusters. Stage IV is 42 inches long, 92 inches diameter, and weighs approximately 2,500 pounds. The axial engine can be vectored up to 15 degrees.

(U) First Flight (17 June 1983) data review revealed several anomalies in stage I and stage II.

(U) Stage I experienced an excessively long (440 versus 250 milliseconds expected) time for chamber pressure to build up and a long tail off time. The cause of the ignition delay was excessive moisture on the propellant grain. The long tail off was due to a propellant casting anomaly. To eliminate the above anomalies the launch eject gas generator (LEGG) was modified and an igniter moisture protection cover was incorporated. Propellant casting processes were reviewed, the source of the anomaly identified, and strict process controls levied to prevent recurrence.

(U) Stage II experienced an extendible nozzle exit cone (ENEC) anomaly which was attributed to an improper locking device on the ENEC actuation system. A fix was implemented on FTM-2, to incorporate sufficient locking force. Stage II ENECs have performed satisfactorily on all subsequent missions.

(U) The second flight test (14 October 1983) with the modified LEGG was conducted at Vandenberg Air Force Base, (VAFB), revealing improved (390 milliseconds) stage I ignition and stage II ENEC operation. The stage I pressure rise time has proven highly repeatable on all flights and is within system requirements.

(U) The third flight (20 December 1983) experienced an ENEC failure at approximately 27 seconds into stage III operation. The failure was attributed to loss of the heat shield that protects the ENEC deployment actuator from heat from the cone. Subsequently Hercules has added additional insulation to the actuator and has strengthened the heat shields to prevent loss. These corrections are for FTM-4 and up. The fourth flight (30 March 1984), fifth flight (15 June 1984) and sixth flight (1 October 1984) experienced no ENEC problems.

Budget Activity: 3, Strategic Programs
Program Element: 64312F, Peacekeeper

(U) The fifth flight (15 June 1984) expended stage I motor case was successfully recovered and examined. Data showed normal nozzle erosion, but higher than normal internal insulation erosion in the forward dome area. The stage I motor case from the seventh flight was also recovered and examined with consistent results. The internal insulation was redesigned by thickening the insulation in the affected area beginning with FTM-9.

(U) The seventh flight (1 February 1985) experienced an ENEC failure at approximately 20 seconds into stage III operation. The failure was attributed to structural failure of the forward ENEC cone. The forward cone has subsequently been strengthened by the addition of a support ring; several other design modifications have been made to reduce loads on the forward cone. These corrections have been made for FTM-8 and up. The modifications have been successfully tested on two firings at Arnold Engineering Development Center (AEDC) and on two flight tests, FTM-8 and FTM-9.

(U) The ninth flight (23 August 1985) was the first launch from a modified Minuteman launch facility utilizing a redesigned launch eject gas generator (LEGG). Stage I ignition delay dropped to 260 milliseconds as expected. After flight, the expended stage I motor case was recovered and examined. Insulation data showed the previous redesign to be adequate and nozzle data to be consistent with earlier flights. No further motor case recoveries are planned.

(U) Stage I has completed a four motor flight proof test program and a four motor pre-qualification test program. In addition, there have been eight successful qualification motor firings. All stage I test firings are conducted at sea level; the other three stages use a mix of sea level testing and simulated altitude testing at Arnold Engineering Development Center (AEDC) or contractor facilities. All flight proof, pre-qualification and qualification stage I test motor firings have been completed. In addition, the first production qualification assurance motor firing was successfully completed on 10 July 1986.

(U) Stage II has completed four flight proof test (FPT) motor altitude firings at AEDC. FPT-1 fired successfully, followed by the FPT-3 failure. The failure mode was identified and solved by trimming propellant in the forward and aft boot areas to relieve restricted gas flow. DS-7A and DS-7B were successfully tested at sea level at Aerojet Strategic Propulsion Company (ASPC) verifying a hand-trimmed grain to be used on first flight. DS-10 and DS-10A were also successfully tested at ASPC, verifying the as-cast grain configuration and a new liner system. The firing of DS-8 at AEDC demonstrated the adequacy of the alternate low density carbon extendible nozzle exit cone (ENEC) cone material. FPT-2 successfully fired at AEDC, veryifying the as-cast grain configuration and new liner system at altitude. FPT-4 successfully completed the FPT motor test series at AEDC and verified the grain at cold temperature. The sixth flight test (1 October 1984) was successfully conducted at VAFB, verifying the as-cast grain configuration. In addition to the FPT program, stage II has also completed a three motor pre-qualification program and has successfully tested seven qualification motors at AEDC. All flight proof, pre-qualification and qualification stage II test motor firings have been completed.

(U) Stage III has completed five successful flight proof test motor altitude firings in the J-5 test cell at AEDC. Hercules has also completed three successful pre-qualification firings at their Tekoi facility and five successful qualification tests at AEDC prior to the qualification test motor number four failure in the J-5 test cell at AEDC on

23 November 1985. The failure mode was identified as a weak propellant liner-to-insulator bond, which subsequently led to case burn through and rupture. To correct this failure mode, additional insulation was added and tighter production process controls were implemented for liner applications. These corrective actions were incorporated into pre-qualification test motor four-alpha, which was successfully tested at Tekoi on 30 April 1986. In addition, a sixth successful qualification test (qualification test motor number eight) was fired at Tekoi on 26 February 1986. Although this firing occurred after the qualification test motor number four failure and after identification of corrective actions, qualification test motor number eight did not include the corrective actions due to program schedule constraints. All flight proof, pre-qualification, and qualification Stage III test motor firings have been completed.

(U) The stage IV FPT program for both screen and bladder tank designs was completed by the successful firings of FPT-1, FPT-2, FPT-3 and FPT-3-R1 (screen tank design). These tests demonstrated flight proof design review design and the flight worthiness of the system. Stage IV has also had two successful pre-qualification firings and three successful qualification firings at AEDC. The first flight test of the screen tank was successfully completed on FTM-9. All flights of stage IV to date have been nominal. All flight proof, pre-qualification and qualification stage IV test motor firings have been completed.

(U) The ordnance system has successfully completed both Flight Termination Ordnance System (FTOS) qualification and Ordnance Initiation Set (OIS) flight proof testings.

(U) The reentry system flight proof testing has been completed successfully at the subassembly and system level. Reentry system performance in flight tests 1 through 9 was nominal in all cases, except for an FTM-9 fuze anomaly which is currently being evaluated. The electronics package for the reentry system has been modified to accommodate both operational MK 12A and MK 21 reentry vehicles. Flight proof testing for the MK 21 was conducted during FY 1984 and qualification testing was conducted during FY 1985. MK 21s were flown on FTM-5 through FTM-14 with good results.

(U) The only major subsystem that will not be completely tested as an entity is the nuclear warhead. The Department of Energy (DOE) will manage this testing in the same manner that they test other nuclear weapons. The DOE will certify yield and reliability. These figures will be used by the military along with other test data to assess weapon system effectiveness.

(U) The canister development test program began January 1982 using a composite canister at the Nevada Test Site. The initial canister assembly launch test program (CALTP) test series consisted of five launches. This series generally confirmed the cold launch test technique used during the Phase I flight test program. Improvements to the launch eject gas generator and canister-to-missile pads were made to correct anomalies discovered during these development tests.

(U) A second series of five CALTP launches was initiated in May 1984 to confirm hardware specifically designed for the Peacekeeper in Minuteman Silos basing mode. Four of the five planned launches in this series were completed by June 1985. These tests focused on performance of the pre-production hardware and assessment of the gas dynamic

conditions in the simulated upper silo area. All objectives of the test series were completed with the four launches, allowing the cancellation of the fifth test.

(U) Integrated mechanical system development testing was conducted at Vandenberg Air Force Base (VAFB) LF-05 between January and April 1985. These tests successfully validated the Peacekeeper emplacement concept using the emplacer and air elevator. The mechanical systems equipment has now successfully supported transport to VAFB, stage processing, missile assembly, transport to the launch pad for FTM-1 through FTM-8 and missile emplacement in VAFB LF-02, LF-05, and LF-08. These systems will continue to support testing at all Peacekeeper processing and launch facilities.

(U) The Peacekeeper unique environmental control system modifications required in the Minuteman silos were tested in VAFB LF-05. Initial results indicate the system will meet all requirements. Detailed verification of these results through thermal modeling has been completed.

(U) Vertical and lateral shock isolation testing has also been conducted at the manufacturer's plant. The tests were performed by simulating the loading these systems would experience in a nuclear shock environment. The test results confirmed that the vertical shock isolators and lateral foam blocks performance is satisfactory.

(U) Integrated electrical system development testing was conducted at Peacekeeper development test sites (DTL-Seattle and DTL-Vandenberg AFB) and LF-05. The DTLs contain launch facility and launch control facility engineering model hardware which was successfully integrated from both a hardware/hardware and a hardware/software perspective. Peacekeeper operational executive program and the launch control program development program supported the FTM-9 flight test and will continue to be developed and integrated. The FTM-9 software was successfully exercised in LF-05 prior to FTM-9, resulting in additional confidence in the software development program. Starting with FTM-15, operational ground electronics will be used for the DT&E flight tests.

(U) A nuclear hardness and survivability test program of missile materials, components, and subsystems has been ongoing since 1977 when external protection material testing began. This program was completed in 1984. The underground test program consisted of Miners Iron (1980) tests on materials for booster and reentry system, Huron Landing (1982) tests on missile structures and shroud, and MK 21 reentry vehicle testing on Midas Myth (1984), Misty Rain (1985), and Mighty Oak (1986). In 1983 (January-June) an electromagnetic pulse (EMP) test of the Peacekeeper missile was carried out at the advanced research electromagnetic pulse simulation (ARES) facility in New Mexico. A follow-up EMP test of a Peacekeeper with a functional missile guidance and control set is being conducted at ARES. mid-1986. The light initiated high explosive test was run on Stage IV in 1983. MK 21 reentry vehicle airblast and x-ray impulse simulation tests were completed in September 1985.

(U) In support of the Peacekeeper in Minuteman Silos system development, there were a large number of tests in the late 1984, early 1985 time period. One such test was a shock isolation system (ground shock) test. This test supported a November 1984 critical design review. An electrical surge arrester vault test (EMP) is currently ongoing.

Budget Activity: 3, Strategic Programs
Program Element: 64312F, Peacekeeper

In addition, a number of components and subsystems have been or will be tested for EMP, radiation, and/or mechanical environments. All such testing will be completed by September 1987.

(U) A Class II development test of the common airborne launch control center (ALCC) system was conducted between April and August 1985, with a series of ground tests and four flight tests. Engineering models were tested to assess fulfillment of design requirements and verification of interface compatibility. Flight tests were conducted over the DTL-S, LF-08, and HETF. The performance of the Class II development test program enabled a favorable modification review group decision to proceed with initial operational capability testing scheduled from March to June 1987 using operational hardware and full-up airborne operational program (AOP) software. FTM-18 is currently scheduled to be the first Peacekeeper launch initiated by the new common ALCC system.

(U) Tests on the following subsystems have been scheduled, started, and/or completed as shown:

Test	From	To
Propulsion, Full Scale (Single Stage)	Jun 80	Oct 84
Flight Termination Ordnance System	Aug 80	Oct 84
Flight Software	Jan 81	Dec 82
Advanced Inertial Reference Sphere Sled	Jun 81	Sep 81
Advanced Inertial Reference Sphere Bench	Sep 81	Sep 82
Reentry System Shock and Vibration	Oct 81	Oct 81
Missile Electronics and Computer Assembly	Nov. 81	Dec 82
Reentry System Shroud Fly-Away	Dec 81	Dec 81
Canister Assembly Launch Test Program	Jan 82	Dec 85
Modal Survey	Feb 82	Apr 82
Guidance and Control (G&C) Integration	Mar 82	Sep 85
Reentry Systems Stiffness	Mar 82	Mar 82
Vandenberg Air Force Base Pathfinder (Missile/Pad)	Jun 82	May 83
Reentry System Flight Proof	Jun 82	Mar 83
Missile Assembly Building/Launcher Handling	Sep 82	Jun 83
Guidance and Control Environmental (Flight Proof)	Nov 82	Jan 84
Electromagnetic Pulse/Electromagnetic Interference/Electromagnetic Compatibility	Jan 83	Jun 84
Vandenberg Air Force Base Pad Launches (8)	Jun 83	Jun 85
Reentry System Deployment Module Electronics (DME) Compatibility	Nov 83	Dec 83
Reentry System Qualification (Without DME)	Nov 83	Jun 85
Deployment Module Electronics Radiation	Jan 84	Jun 84
Full-Scale Development Sled	Feb 84	Jul 86

Budget Activity: 3, Strategic Programs
Program Element: 64312F, Peacekeeper

Test	From	To
Reentry Vehicle Flight Proof	Jul 84	Oct 84
Emplacer, Functional	Dec 84	May 85
LF-05 Mechanical Development Test	Jan 85	Apr 85
Vandenberg Air Force Base Pathfinder (Missile/Silo)	Feb 85	May 85
Missile Electronics and Computer Assembly Radiation/System-Generated Electromagnetic Pulse Test	Feb 85	Aug 85
Missile Electronics and Computer Assembly Mechanical Qualification Test	Mar 85	Aug 85
Common ALCC Class II Development Flight Tests	Apr 85	Aug 85
Reentry Vehicle Qualification	Apr 85	Oct 85
Vandenberg Air Force Base Silo Launches (12)	Aug 85	2nd Qtr CY87
Missile Guidance and Control Set Radiation Qualification Test	Oct 85	Jul 86
Inertial Measurement Unit Limit Radiation Test with Missile Guidance Control Set Test	Oct 85	Jul 86
Deployment Module Electronics Qualification	Oct 85	Dec 85
MK 21 Fuze Radiation	Nov 85	Jun 86
Missile Guidance and Control Mechanical Qualification Test	Nov 85	Apr 86
Inertial Measurement Unit Mechanical Qualification Test	Mar 86	Aug 86
Missile Electromagnetic Pulse Test (T607)	Apr 86	Oct 86
Common ALCC Electromagnetic Compatibility Margin Test	Jul 86	Sep 86
LF-05 Electromagnetic Interference/Electromagnetic Compatibility Testing	Jan 87	Mar 87
Common ALCC Class II Pre-IOC Test	Mar 87	Jun 87

2. (U) Operational Test and Evaluation (OT&E): This is a combined DT&E/OT&E program, with AFOTEC managing the OT&E portion. OT&E objectives have been fully integrated with DT&E objectives to reduce schedule and cost impacts. An AFOTEC test team has been formed which includes personnel from SAC, AFLC, AFCC, ATRC, and AFOTEC. All test scenarios will be structured to accommodate the objectives of the combined test program and satisfy the five operational critical issues: mission effectiveness, probability of damage, survivability, weapon system integration, and weapon system operation and support. A program of 20 launches with evolution from mainly DT&E- to OT&E-oriented objectives is planned.

(U) Fifteen of the planned 20 Peacekeeper test launches have been completed. The first four phases of the missile launch program (does the booster work?) ended with the successful launch of the fifth Peacekeeper on 15 June 1984. The second phase of testing (how well does the missile system work?) completed with the successful thirteenth launch on 23

Budget Activity: 3, Strategic Programs
Program Element: 64312F, Peacekeeper

August 1986. The second phase concentrated on stressing the missile and reentry vehicle through more operationally relevant target profiles with increasing emphasis on the development and test of hardware and software necessary for system integration. The integration of ground and flight systems began with the successful ninth flight (23 August 1985), the first launch from a Minuteman silo, and continued with flights ten through thirteen. Greater emphasis on OT&E was demonstrated with the increased use of operational crews and maintenance personnel during flights eleven through fifteen.

(U) Phase three of the test program (will it work as a weapon system?) began with the fourteenth launch (18 September 1986). This was the first launch with a combined reentry vehicle and penetration aids payload. The reentry vehicle deployment was successful; however, the penetration aids deployment system did not release and deploy decoys. An evaluation of this anomaly is in progress. Phase three of the test program will continue with flight 16, emphasizing the operational subsystem configuration and flight profiles. The last phase (scheduled for completion in mid-1987 and consisting of the final four launches) will further verify the operational procedures and any configuration block changes.

3. (U) *System Characteristics:*

(U) Because the weapon system has many elements that contribute to its effectiveness, and because management tradeoffs between these elements are necessary to identify the most cost effective combination, Peacekeeper In Minuteman Silos program thresholds and goals have been established at the weapon system level.

(U) The threshold established for the Peacekeeper In Minuteman Weapon System by the Program Management Directive is the mission effectiveness factor (MEF).

(U) MEF is defined as the product of launch (countdown) and flight reliability, weapon system availability, and targeting efficiency.

The MEF goal is [ ] and the threshold is [ ] as of May 1986 the MEF is [ ]

(U) Launch (countdown) and flight reliability is defined as the probability that an available missile system will, disregarding the effects of enemy action, respond to a valid launch command and will successfully complete launch and flight resulting in the detonation of a given warhead within 3.5 times the circular error probable requirement. During the DT&E/OT&E program, the operational launch (countdown) and flight reliability will be assessed using flight testing and applicable ground testing such as motor static testing, launch system testing, command, control and communication testing, and guidance and control testing. It is anticipated that failures will occur during the early phase of the flight test program. Causes of the failures will be corrected through a reliability improvement program. Test data will be modified or purged only after sufficient testing has been accomplished to verify the effectiveness of the corrective action. The limited data base available at initial operational capability (IOC) will not support a high level of confidence in the assessed launch (countdown) and flight reliability value. Strategic Air Command follow-on

operational test and evaluation results accumulated after IOC will increase confidence in the accuracy of this assessment.

(U) Weapon system availability is defined as the percentage of a missile force, under the jurisdiction of the using command and committed to the wartime mission, which is capable of commitment to the launch sequence at any random point in time. Prior to IOC, availability predictions will be based upon a probabilistic availability model. Simulations will be used as necessary to verify the availability prediction and to generate inputs to the model for variables such as spares availability that are not conducive to probabilistic solution. Subsequent to IOC, actual field experience as reported by the Strategic Air Command will be the basis for availability assessments.

(U) Targeting efficiency is defined as the ratio of the number of targets in a reference target list to the number of reentry vehicles flown to achieve 100% coverage of that same target list. The targeting efficiency assessment will be continually updated from the missile system engineering studies to track the performance of the Peacekeeper missile during the DT&E/OT&E program. Missile parameters, such as subsystem weights and motor specific impulse, may vary during development and test. If so, this will influence missile performance against various target structures.

(U) Accuracy is a measure of the miss distance for a reentry vehicle that has been delivered to the target area. Accuracy is expressed as circular error probable which is defined as the radius of a circle centered on an aim point within which 50% of the reentry vehicles are expected to be located at impact.

(U) The evaluation of accuracy is a continuing process which begins with the design of the weapon system and continues throughout the life of the flight test program. Initially, error budgets are established at the subsystem level to derive an accuracy budget at the weapon system level. The major subsystems for categorizing accuracy include guidance and control, targeting, geodetics and geophysics, and reentry. Guidance and control includes inertial measurement unit (including gyroscopes and accelerometers), hardware errors, ground program errors, flight program errors and certain elements in the deployment sequence. Reentry subsystem errors include the reentry vehicle, certain elements of separation, and reentry dispersion due to atmospheric conditions. Targeting and geodetic and geophysical evaluations, are primarily accomplished by computer simulations.

(U) During the Peacekeeper In Minuteman Silos test program, flight test results will be used to validate the engineering estimates. Confidence in achieving the system accuracy goal will increase during DT&E/OT&E ground and flight testing. A mature system accuracy assessment will be completed approximately 3-5 years after Peacekeeper In Minuteman Weapon System initial operational capability.

The operational accuracy goal for the mature Peacekeeper system is [ ] at a north-firing range of [ ] Current engineering estimates and flight test data indicate this goal will be achieved.

(U) The Peacekeeper missile has the following additional characteristics:

Budget Activity: 3, Strategic Programs
Program Element: 64312F, Peacekeeper

1. (U) The Peacekeeper will weigh 195,000 pounds.

2. (U) The Peacekeeper will deliver a payload of up to 10 MK-21 reentry vehicles.

3. The Peacekeeper will have a range of [ ] with an accuracy of [ ]

4. (U) The system will have a remote fault detection capability to isolate 95 percent of all launch critical faults to a line replacement unit on Peacekeeper unique equipment.

5. The system will provide [ ]

4. (U) Current Test and Evaluation (T&E):

T&E Activity (Past 12 Months)

Event	Planned Date	Actual Date	Remarks
Eleventh flight	1st Qtr CY 86	Mar 86	Demonstrated capability to deploy MK-21 RVs and nominal trajectory.
Twelfth flight	2nd Qtr CY86	May 86	Demonstrated the capability to deploy a full complement of 10 MK-21 reentry vehicles.
Missile Emplacement Test	2nd Qtr CY86	May 86	Demonstrated the capability to assemble the missile in the launch facility using production equipment.
Power and Environmental Control System Tests	2nd Qtr CY86	Jun 86	Demonstrated the capability to provide power and environmental control in the modified launch facility during all modes of operation.
Command and control test	3nd Qtr CY86	In Progress	Demonstrate capability of the modified Minuteman communications system to satisfactorily command and control Peacekeeper missiles
Thirteenth flight	3rd Qtr CY86	Aug 86	First launch from a fully operational configured launch facility. Demonstrated capability to deliver reentry vehicles over an enlarged footprint including RV land impact.

Budget Activity: 3, Strategic Programs
Program Element: 64312F, Peacekeeper

Event	Planned Date	Actual Date	Remarks
Fourteenth flight	3rd Qtr CY86	Sep 86	First launch with combined reentry vehicle and penetration aids payload. All 6 reentry vehicles successfully deployed. Penetration aids deployment system did not release and deploy decoys.
Operations Demonstration Test	3rd Qtr CY86	Sep 86	Demonstrated capability to bring missiles on alert and to command and control Peacekeeper missiles using operational scenarios in a simulated squadron environment.
Fifteenth flight	4th Qtr CY86	Dec 86	Demonstrated the capability to deliver a full complement of 10 reentry vehicles following an extended alert period.

T&E Activity (Next 12 Months)

Event	Planned Date	Remarks
Sixteenth flight	1st Qtr CY87	Demonstrate the capability to launch using alternate power source (batteries) and deploy RVs over an enlarged footprint including land impact.
Seventeenth flight	1st Qtr CY87	Demonstrate the capability to deploy penetration aids.
Eighteenth flight	1st Qtr CY87	Demonstrate capability to fly an extended range mission and launch with Airborne Launch Control System.
Airborne launch test	1st/2nd Qtr CY87	Demonstrate capability of the new common airborne launch control center to command and control Peacekeeper missiles.
Nineteenth flight	2nd Qtr CY87	Demonstrate the capability to launch with the Airborne Launch Control System and deploy reentry vehicles over an enlarged footprint.
Twentieth flight	2nd Qtr CY87	Demonstrate the capability to launch with the Airborne Launch Control System using alternate ground power (batteries) and to deliver reentry vehicles over an extended footprint.

Budget Activity: 3, Strategic Programs
Program Element: 64312F, Small Intercontinental Ballistic Missile

Test and Evaluation Data

1. (U) Development Test and Evaluation (DT&E):

(U) The Ballistic Missile Office (BMO), Norton AFB, CA, is the Air Force Program Management agency responsible for development of the Small Intercontinental Ballistic Missile (Small ICBM) Weapon System. BMO is also the responsible test organization for DT&E. The Air Force Operational Test and Evaluation Center is responsible for initial operational test and evaluation (IOT&E). The Strategic Air Command will operate the Small ICBM and will, jointly, with the Air Force Logistics Command be responsible for maintaining the system. Principal development contractors are: Aerojet General Corporation, Avco, Hercules Aerospace Corporation; Martin Marietta Corporation; Northrop Corporation; Rockwell International, Autonetics Division; The Boeing Company; Morton-Thiokol Incorporated; General Electric Company; United Technologies, Chemical Systems Division; Litton; Ford Aerospace, and Charles Stark Draper Laboratories.

(U) This testing will provide hardware design data which will assure more comprehensive verification of compliance with specifications and a more realistic estimate of life cycle system costs. The test program will initially evaluate areas of design risk in guidance, motor and nozzle, reentry system, operational launcher, command, control, and communications (C^3), ground power, physical security system, and nuclear hardness and survivability. Contractor test facilities; Arnold Engineering and Development Center (AEDC), Tullahoma, TN; Rocket Propulsion Lab, Edwards Air Force Base, CA; Holloman Air Force Base, NM; Yuma Providing Ground, AZ; Kirtland Air Force Base, NM; and Vandenberg Air Force Base, CA, are to be used for most of the testing.

(U) The DT&E program to date has concentrated primarily on validatation of concepts and technologies to reduce/quantify risk prior to entry into full-scale development; i.e., propulsion, mobility, guidance ordnance, and survivability/hardness testing. Results indicate the program is low to moderate in technical risk. A general test plan and an integrated test plan have been developed. A test and evaluation master plan has also been developed and coordinated through the office of the Secretary of the Air Force.

(U) A total of 22 test flights from the Western Test Range at Vandenberg AFB (VAFB), CA have been planned. These flight tests constitute the development test and evaluation/initial operational test and evaluation (DT&E/IOT&E) program and are followed by approximately 108 operational test and evaluation flights conducted by the Strategic Air Command. The flight test articles will be configured with a test reentry vehicle and an instrumentation and range safety system. The test and evaluation objectives are to evaluate missile performance and reliability and to asess the capability of the guidance and control units to achieve accuracy. Ground system interface, stage performance, post boost vehicle performance, and time of flight performance capabilities are also included in the list of the test and

evaluation objectives. The first five launches will be from a test pad to evaluate the missile. The remaining DT&E/IOT&E flights will be launched from hard mobile launchers (HML) systems to evaluate missile and HML interface and launch parameters.

(U) DT&E on guidance and control is in two parts. The first part occurred during pre-full scale development (Pre-FSD). Competing alternate inertial navigation systems (AINS) were evaluated by laboratory testing and testing later by sled at Holloman Air Force Base, NM. The primary purpose of those tests was calibration and alignment, functional testings, and accuracy testing of the AINS supporting the down-select in October 1986. The General Electric and Litton systems were selected and will be flight tested aboard a Minuteman III (MM III) missile. These tests evaluate the relative performance of the various navigation systems in a flight environment. The MM III flight tests support a second down-select in January 1988 where it will be decided if an AINS will be used as the operational navigation system in lieu of the advanced inertial reference sphere (AIRS) used in the Peacekeeper weapon system.

(U) The second part of DT&E occurs during full-scale development (FSD). During this phase, the entire missile guidance and control system will be tested and evaluated with respect to performance (function and accuracy) of missile subsystems in a benign flight environment. All airborne vehicle and ground support equipment will be tested prior to flight during Pathfinder (an electrically and mechanically representative missile) testing at Vandenberg Air Force Base (VAFB). Ground testing at VAFB includes an end-to-end polarity test of the missile system.

(U) The evaluation of accuracy is a continuing process which begins with the design of the weapon system and continues throughout the life of the flight test program. Initially, error budgets are established at the subsystem level to derive an accuracy budget at the weapon system level. The major subsystems that contribute to accuracy include guidance and control, targeting, geodetic and geophysics, and reentry. Allocated to the guidance and control subsystem is inertial measurement unit hardware errors, ground program errors, flight program errors, and certain elements in the deployment sequence. Reentry subsystem errors include the reentry vehicle and certain elements of separation. Characterization of individual components such as targeting and guidance and control is primarily accomplished by computer simulations.

(U) Land navigation testing and sled testing will be conducted to determine ground navigation performance and to assess azimuth alignment subsequent to land movement.

(U) The 21-month solid rocket booster stages competition is near completion. During this Pre-FSD phase, four contractors developed and demonstrated propulsion technologies and design concepts leading to high performance at low risk. A total of 19 full-scale stages were fired, including competitive performance evaluations under simulated altitude conditions at Air Force Rocket Propulsion Laboratory and Arnold Engineering Development Center. High strength carbon fiber motor components were demonstrated with 24 case burst tests and 8 MANTECH (Manufactoring Technology) nozzle firings. High energy solid propellant ballistics, performance, and safety hazards were evaluated at Air Force and Department of Energy facilities. These validated test results form the basis for selecting winning stage designs to enter FSD by the end of 1986.

Budget Activity: 3, Strategic Programs
Program Element: 64312F, Small Intercontinental Ballistic Missile

(U) The Small ICBM assembly test and system support contract, which includes the post boost vehicle and shroud was awarded to Martin Marietta Corporation, in July 1985.

(U) New missile handling equipment, such as end-rings and carriages, is being developed to support the Small ICBM program including Pathfinder assembly at Vandenberg Air Force Base (VAFB) and future launches. Prior to delivery to VAFB for the integrated test program, subelement and assembled components will be tested at the manufacturer's plant. This will functionally demonstrate the erection, roll transfer, and hoist operations necessary for missile assembly.

(U) The only major subsystem that will not be completely tested as an entity is the nuclear warhead. Safety and treaty agreements require that it be tested in segments. These tests, both on the ground and in flight, are in ways that will never produce a full yield. The Department of Energy (DOE) manages this testing in the same manner that they test other nuclear weapons. The DOE will certify yield and reliability. The Small ICBM will use the Mark 21 reentry vehicle and W87 warhead developed by the Peacekeeper program. The DT&E/IOT&E flight test program does not involve a nuclear event.

(U) A nuclear hardness and survivability program on missile materials, components, and subsystems has been an ongoing effort on the Peacekeeper and Small ICBM programs. Much of the Peacekeeper data will be transferrable to the Small ICBM Program. For the underground test programs, the Mark 21 was tested on Midas Myth (1984) and Mighty Oak (1986), Small ICBM motor case and external protection materials were tested on Misty Rain (1985), ring laser gyros and laser fiber optics were tested on Mighty Oak (1986), and further Small ICBM experiments are planned for an underground test during 1989. Peacekeeper electromagnetic pulse testing is being completed, during 1986, to support definition of electromagnetic pulse test requirements for the Small ICBM. External protection materials were tested for pebble impact, fireball and aero heating effects, and X-ray environments during 1985-1986.

(U) A nuclear hardness and survivability program on the hard mobile launcher (HML) has been on-going since 1985. The HML was tested in the Minor Scale above ground high explosive blast precursor simulation experiement. The HML will also be tested on a similar experiment in Misty Picture (1987). Shock tube testing of the HML was completed in 1986 demonstrating stability of the launcher design when exposed to nuclear precursor blast environments. Additional testing is planned during full-scale development to quantify design stability under various deployment conditions. In addition to parts, components, and subsystem nuclear environment testing, system level testing (including missile) is planned to address electromagnetic pulse, radiation, and blast/shock environments.

(U) Mobility testing of full size engineering test models of the HML was also conducted, October 1985 through August 1986. The majority of testing was conducted at the U.S. Army's Yuma Proving Ground, Arizona. Security Systems for mobile elements will be tested during the full-scale development phase (FSD).

(U) DT&E on the weapon control system (WCS) will be conducted during the FSD phase. The performance of WCS elements of the launch control center (LCC) and in the HML will be tested during Pathfinder testing prior to launch of

flight test missile six (FTM-6). The remainder of the WCS elements will be tested with subsequent flight tests and ground tests.

(U) A similar competition for the ordnance firing system led to the selection of a laser initiation approach in July 1986. This new technology offers increased operational flexibility, with reduced cost and weight, while maintaining high reliability. A full range of environmental and functional testing on prototype flight weight units, and excellent survivability demonstrated in an underground nuclear test, proved this laser firing concept.

2. (U) Operational Test and Evaluation (OT&E):

(U) With test start in January 1988, this will be a combined DT&E/OT&E program, with AFOTEC managing the OT&E portion. OT&E objectives have been fully integrated with DT&E objectives to reduce schedule cost impacts. When formed, the AFOTEC test team will include personnel from SAC, AFLC, AFCC, ATC, and AFOTEC. All test scenarios will be structured to accommodate the objectives of the combined test program and satisfy the five operational critical issues: survivability, operational performance, operation and support (R&M), weapon control system, and physical security. A program of 22 launches with evolution from mainly DT&E- to OT&E-oriented objectives is planned.

3. (U) System Characteristics:

Characteristic	Objective Threshold	Demonstrated
(U) Missile Weight	30,000 lbs	*
(U) Throwweight	10,000 lbs at 6,000 NM	*
(U) Deployment	Compatible with Mobile or Fixed Basing	*
Accuracy	Circular Error Probable of [ ]	*

(U) * To be demonstrated during full scale development.

(U) Accuracy is a measure of the miss distance for a reentry vehicle that has been delivered to the target area. Accuracy is expressed as circular error probable which is defined as the smallest radius of a circle centered on the aim point within which 50% of the reentry vehicles are expected to be located at airburst or impact.

(U) During the Small ICBM test program, flight test results will be used to validate the engineering estimates. Confidence in achieving the system accuracy goal will increase during DT&E/OT&E ground and flight testing. A mature system accuracy assessment will be completed approximately 3 years after Small ICBM Weapon System Initial Operational Capability.

Budget Activity: 3, Strategic Programs
Program Element: 64312F, Small Intercontinental Ballistic Missile

4. (U) Current Test and Evaluation:

T&E Activity (Past 12 Months)

Event	Planned Date	Actual Date	Remarks
Pre-Full Scale Development Activities	Jan-Dec 86	Jan-Dec 86	Test Planning

T&E Activity (Next 12 Months)

Event	Planned Date	Remarks
Minuteman III Guidance Flight Tests	Mar & Jun 87	Flight test of Alternate Inertial Navigation Systems (AINS) guidance systems to evaluate relative performance in a flight environment.
Land Navigation Tests	Mar-Jun 87	Test the ability of the guidance and control assembly (GCA) to perform its navigation function and its ability to maintain accurate alignment and calibration.
Stage Firing-Stage I	Mar, Jun & Jul 87	Evaluate stage performance at contractor facility.
Misty Picture	May 87	Above ground high explosive blast precursor simulation experiment testing Hard Mobile Launcher nuclear hardness and survivability.
Stage Firing-Stage II	May & Dec 87	Evaluate stage performance at AEDC.
Post Boost Vehicle (PBV) Firing	Jun & Aug 87	Evaluate PBV performance.
Shroud Seperation Test	Jul 87	Evaluate shocked induced by shroud separation and verified shroud separation clearances from the PBV, Shroud Reentry Assembly (PSRA).
Stage Firing-Stage III	Jul & Nov 87	Evaluate stage performance at AEDC.
Canister Assembly	Oct & Dec 87	Tests to confirm the test launcher to missile interfacing subsystems and launch eject performance.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64361F
DOD Mission Area: 113 - Airborne Strike

Title: Air-Launched Cruise Missile, AGM-86B
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional To Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	9,078	4,792	3,591	958	1352	1,158,800

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Air Launched Cruise Missile (ALCM) greatly enhances the air breathing leg of the Triad by: stressing and diluting Soviet defenses, thus improving the overall penetration prospects of the mixed air breathing force; compelling the Soviets to devote substantial resources to their national air defenses to counter this threat; increasing the number of weapons in our strategic forces in the near term and convincing the Soviets that their massive air defense efforts will not substantially blunt U.S. air breathing strike capabilities.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional To Completion	Total Estimated Cost
RDT&E	10,894	6,065	3,703	N/A	0	1,170,100
Missile Procurement	32,640	12,407	2,470	1,207	0	2,733,700

(U) The reduction in FY 1986 RDT&E of $1.8 million resulted from Congressional action and Gramm-Rudman reductions.
(U) The reduction in FY 1987 RDT&E of $1.4 million reflects Congressional reductions and inflation adjustments.
(U) The increase in FY 1989 RDT&E of $1 million reflects funding to complete the ALCM/B-1B R&D integration effort, mission planning improvements and missile software changes.

4. OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional To Completion	Total Estimated Cost
Missile Procurement	30,420	12,053	2,347	1,186	0	2,597,500
(Missile Quantity)	(0)	(0)	(0)	(0)	(0)	(1715)
Military Construction	20,280	0	0	4,700	4,965	280,300

Program Element: 64361F
DOD Mission Area: 113 - Airborne Strike

Title: Air-Launched Cruise Missile, AGM-86B
Budget Activity: 3 - Strategic Programs

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional To Complete	Total Estimated Cost
Department of Energy Costs* (W-80 Warhead)	[					]

* W-80 cost based on [ ] warheads.

5. (U) RELATED ACTIVITIES: The AGM-86B Air-Launched Cruise Missile (ALCM) program is managed by Air Force Systems Command's Aeronautical Systems Division, Wright-Patterson AFB, OH. The ALCM, the land attack Sea-Launched Cruise Missile (SLCM), and the Ground Launched Cruise Missile (GLCM) programs are structured to have maximum commonality in engine and navigation/guidance subsystems. The ALCM and SLCM share the common W-80 nuclear warhead developed by the Department of Energy. The engine and navigation/guidance projects are jointly managed through the Joint Cruise Missiles Project Office. The B-52 Squadrons, PE 11113F, is also related to the ALCM. The B-52 Cruise Missile Carriage, Offensive Avionics System, and other projects require close coordination with the ALCM program to ensure full compatibility.

6. (U) WORK PERFORMED BY: The major contractors are: Boeing Aerospace, Seattle, WA (air vehicle); Williams International Corporation, Walled Lake, MI; Teledyne CAE, Toledo, OH (engine); Litton Industries, Woodland Hills, CA; Litton of Canada Limited, Toronto, ONT; and Minneapolis Honeywell, Minneapolis, MN (navigation guidance). In-house developing organizations are: Defense Mapping Agency and the Joint Cruise Missiles Project Office.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 64361F, Air-Launched Cruise Missile

A. (U) Project Description: The ALCM is a small, long range, accurate, nuclear armed air-to-ground cruise missile. The missile is powered by a small turbofan engine in the 600 pound thrust category. Missile navigation is accomplished by means of an inertial navigation system and a terrain contour matching system. ALCM carriage and launch will be from bomber aircraft. Initially, ALCMs will be carried on B-52G/H aircraft on external pylons and internally on launchers (B-52G external only, B-52H both external/internal). The B-1B aircraft will also be cruise missile capable for use in the 1990s and beyond.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: The ALCM program continued to update and improve mission planning operational test software. Also, a major effort to define the detailed modifications needed to support the integration of the ALCM into the B-1B weapon system was initiated. In addition, mission and miscellaneous support were provided.

(2) (U) FY 1987 Program: The FY 1987 program will provide the Strategic Air Command with an Operational Test Launch (OTL) mission planning capability and an improved mission planning computer program which established the mission

terrain following altitude setting. Development of an integrated ALCM/Short Range Attack Missile (SRAM) OTL payload checkout test set.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The FY 1988 program completes development of the ALCM/SRAM OTL test set, revises mission planning software (Navigation Accuracy Module), revises missile software for a new radar altimeter, initiates the final phase of B-1B integration tests for B-1B flight testing and makes Electronics System Test Set (ESTS) compatibility changes. Coat estimates are based on firm contractor prices for this mature production program.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The FY 1989 program completes the ALCM/B-1B R&D acoustic integration testing, mission planning improvements and missile software changes.

(5) (U) Program to Completion: The program will be completed in FY 1990 with accomplishment of required missile modification and other PMRT residual tasks.

C. (U) Major Milestones:

	Milestones		Dates
(1) (U)	Defense Systems Acquisition Review Council I (Prog. Initiation)		February 1974
(2) (U)	Defense Systems Acquisition Review Council IA (AGM-86A)		March 1975
(3) (U)	First Powered Flight (AGM-86A)		March 1976
(4) (U)	Defense Systems Acquisition Review Council II (AGM-86A/B)		January 1977
(5) (U)	AGM-86B/AGM-109 Competition Directed		July 1977
(6) (U)	First Full-Scale Engineering Flight		July 1979
(7) (U)	Source Selection		March 1980
(8) (U)	Defense Systems Acquisition Review Council III (Production Decision)		April 1980
(9) (U)	First Alert Capability (One B-52G)		September 1981
(10) (U)	Initial Operational Capability (First B-52G Squadron)		December 1982
(11) (U)	Full Operational Capability (AGM-86B)	*(FY 1987)	Fiscal Year 1989

*Date presented in the FY 1987 Descriptive Summary

Explanation of Milestone Changes:

(11) (U) This is an administrative change; Fiscal year 1989 has always been the year planned when the last B-52 squadron will be modified to carry ALCM.

8. (U) COOPERATIVE AGREEMENTS:

Canada - This Technical Arrangement, signed 14 Feb 84, concerns authorization of overflights of the AGM-86B Air-Launched Cruise Missile (ALCM) over Canadian territory. The agreement comprises the ground-rules for U.S. Test and

Program Element: 64361F
DOD Mission Area: 113 - Airborne Strike

Title: Air Launched Cruise Missile, AGM-86B
Budget Activity: 3 - Strategic Programs

Evaluation of the ALCM over Canada and limits the flight tests to a maximum of 6 launches in any one 12 month period. Also, all launch dates must be scheduled in the first quarter of the calendar year. To date, [ ] U.S. Forces retain custody/control over all U.S. weapons and are assisted in conducting surveillance and security by the Canadians. Cumulative cost for this support is $300 thousand dollars (Canadian).

Budget Activity: 3. Strategic Programs
Program Element: 64361F/11122F, Air-Launched Cruise Missile (ALCM)

Test and Evaluation Data

1. (U) Development Test and Evaluation (DT&E): In 1975 and 1976, six advanced development tests were conducted on the short range Boeing AGM-86A Air-Launched Cruise Missile (ALCM). Four of the six flight tests were successful.

(U) The Full-Scale Development (FSD) program for the long range ALCM was structured into two phases. The first phase was the competitive flyoff between the Boeing ACM-86B and the General Dynamics ACM-109. The ten flights per competitor were further divided into three DT&E flights conducted by contractors and seven DT&E/Initial Operational Test and Evaluation (DT&E/IOT&E) flights conducted by a joint Air Force DT&E/IOT&E test team. The Boeing ACM-86B was chosen to enter production in April 1980. The second phase consisted of 20 follow-on flights to support B-52G Integrated Weapon System (IWS) testing.

(U) The majority of the reliability and maintainability testing was conducted during the follow-on test program when sufficient production configured support equipment was available. During the flyoff the contractors were expected to demonstrate a test reliability of .575 to .744 for a hypothetical mission of 12 hours captive carry and 5 hours of free flight. The AGM-86B achieved a value of .68 .

(U) Other contractors in the ALCM program are Williams International, Walled Lake, MI for the engine, with Teledyne CAE, Toledo, OH, the second source. Inertial Navigation Elements are provided by Litton, Woodland Hills, CA and Litton of Canada, Toronto, Canada. Missile Radar Altimeters are provided by Honeywell, Minneapolis, MN. Boeing Military Aircraft Company, Wichita, KS is the cruise missile integration contractor responsible for B-52C modification and integration. The production decision which approved full rate ALCM production occured in April 1980.

(U) Development Test Reports published: AGM-86 Air Launched Cruise Missile (ALCM) Development Test and Evaluation Competitive Test Program, Vol I thru VI, May 1980 and AGM-109 Air Launched Cruise Missile (ALCM) DT&E Competitive Test Program, Vol I thru VI, May 1980.

2. Operational Test and Evaluation (OT&E): The Air Force Operational Test and Evaluation Center (AFOTEC) was responsible for IOT&E and the early phase of Follow-on Operational Test and Evaluation (FOT&E) of the ALCM. The ALCM test team was located at Edwards AFB, California, and comprised of personnel from AFOTEC, Strategic Air Command (SAC), Air Force Logistics Command and Air Training Command. The Integrated Weapons System (IWS) Program combines ALCM and Offensive Avionics System (OAS) testing.

Budget Activity: 3. Strategic Programs
Program Element: 64361F/11122F, Air-Launched Cruise Missile (ALCM)

(U) The Defense Systems Acquisition Review Council (DSARC) III, which met on 17 April 1980, provided direction for production, Follow-on Operational Test and Evaluation (FOT&E), continuation of reliability and maintainability efforts, and management attention on improving Boeing Aerospace Company quality assurance for this program.

(U) Air-Launched Cruise Missile FOT&E testing from April 1980 through May 1981 consisted of 11 ALCM launches from a non-Offensive Avionics System (OAS) B-52G used during the competition. All subsequent launches were from B-52Gs equipped with OAS. A total of 20 launches were conducted during the period between the flyoff and Initial Operational Capability (IOC) in December 1982. Fourteen successes, 3 partial successes and 3 failures resulted. Overall, the Air Force Operational Test and Evaluation Center rated the IWS as potentially capable of fulfilling Strategic Air Command's (SAC) requirements.

(U) SAC-conducted ALCM FOT&E Phase I began July 1983 and will continue throughout the system's operational life cycle. Approximately twelve ALCM launches are scheduled each fiscal year from operational SAC bomb wings under the nickname "GLOBAL CRUISE". This testing is managed by Headquarters SAC and conducted by the 4201st Test Squadron. The ALCM FOT&E program is designed to test the complete weapon system in the most operationally realistic environment possible. Present limitations to testing are airspace constraints, weather criteria and terrain diversity; missions over the Canadian route flown in 1985 and planned for future years will significantly increase the realism in all three areas. SAC's ALCM testing is also included in the framework of the B-52 Offensive Avionics System (OAS), ALCM, Short Range Attack Missile (SRAM) and delivery of nuclear gravity weapons as an integrated weapon system. Specific test objectives are designed to:

a. Provide inputs to SAC planners in determining weapon system accuracy and reliability.
b. Verify current employment concepts, tactics and techniques, and identify operational deficiencies.
c. Verify adequacy of technical data and equipment currently used in maintenance, check-out and operation of the weapon system.
d. Evaluate the performance of the weapon system to include aircrew, software and hardware.
e. Continue evaluation of those areas recommended as a result of previous testing.

(U) To date, operational performance demonstrated by FOT&E has met the advertised specifications in suitability, reliability, and maintainability. Important results achieved from recent testing include the validation of revised software for the ALCM and the captive carry of an ALCM over the Canadian Test Route.

(U) Test Reports Published:
(1) ALCM OT&E Final Report, Headquarters Air Force Test and Evaluation Center (HQ AFTEC), September 1981.
(2) ALCM Survivability Follow-on Operational Test and Evaluation Final Report, HQ AFTEC, May 1982
(3) B-52 Integrated Weapon System (IWS) Operational Test and Evaluation Follow-on Operational Test and Evaluation Final Report, HQ AFOTEC, September 1983.
(4) Global Cruise B-52 Integrated Weapon System Follow-on Operational Test & Evaluation (U) Test Report 1 July - 31 October 1983, HQ SAC, 1 March 1984.

Activity: 3. Strategic Programs
Program Element: 64361F/11122F, Air-Launched Cruise Missile (ALCM)

3. System Characteristics:

Physical Characteristics	AGM-86B (ALCM)
Length (feet)	20.75
Diameter (inches)	27.30
Weight (pounds)	3144
Wing Span (feet)	12
Wing Area (square feet)	11
Warhead Yield (kilotons)	[ ]
B-52 Internal Carriage (each)	8
B-52 External Carriage (each)	12

Characteristic	Objective	Demonstrated
Maximum Low Altitude Speed (Mach number)	[	]
Minimum Launch Altitude (feet)		
Minimum Enroute Altitude (feet)		
Propulsion Range (kilometers) 1/	]	
System Operational Range (kilometers)	2500	2500
Accuracy (Circular Error Probable-feet) 2/	[ ]	[ ]

1/ Low altitude at [ ]

2/ At [ ] last fix within [ ] nautical miles of target, terminal cell size [ ]

4. (U) Current Test and Evaluation (T&E):

T&E Activity (Past 12 Months)

Event	Planned Activity	Actual Date	Remarks
ALCM Launch	22 Jan 86	22 Jan 86	Success-1st Canadian launch
ALCM Launch	25 Feb 86	22 Feb 86	Failure-no engine start
ALCM Launch	27 Feb 86	Cancelled	Due to 22 Feb 86 crash investigation
ALCM Launch	08 Apr 86	22 Apr 86	Success-2nd OAS launch

Budget Activity: 3. Strategic Programs
Program Element: 64361F/11122F, Air-Launched Cruise Missile (ALCM)

(U) Current Test and Evaluation (T&E):

T&E Activity (Past 12 Months)(Continued)

Event	Planned Activity	Actual Date	Remarks
ALCM Launch	9 May 86	15 Jun 86	Success-ALCM/SRAM gravity releases; delayed for weather
ALCM Launch	17 Jun 86	8 Jul 86	Success-3rd OAS/2nd CSRL Delayed for weather
ALCM Launch	15 Jul 86	18 Jul 86	Failure-missile power supply Delayed for weather
ALCM Launch	12 Aug 86	Delayed	Due to 18 Jul 86 crash investigation
ALCM Launch	9 Sep 86	Cancelled	No mission support aircraft
ALCM launch	6 Oct 86	6 Oct 86	Failure-mission planning software error

T&E ACTIVITY (Next 12 Months)

Event	Planned Activity	Remarks
ALCM Launch 87-4	12 Jan 87	
ALCM Launch 87-5	Feb 87	Canadian flight
ALCM Launch 87-5A	Feb 87	Canadian flight
ALCM Launch 87-7	20 Apr 87	
ALCM Launch 87-8	11 May 87	
ALCM Launch 87-9	29 Jun 87	
ALCM Launch 87-11	10 Aug 87	
ALCM Launch 87-12	14 Sep 87	
ALCM Launch 87-12A	16 Sep 87	
ALCM Launches 88-1,2,3	TBD	

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64406F
DOD Mission Area: 123 - Space Defense

Title: Space Defense Systems
Budget Activity: 3 - Strategic Programs

1. (U) **RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)**

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		143,597	189,285	402,358	385,812	Continuing	N/A
2134	Miniature Systems	143,597	172,985	277,958	248,092	Continuing	N/A
2135	Advanced Systems*			77,750	88,880	Continuing	N/A
3647	Ground Based Laser Technology*		16,300	46,650	48,840	Continuing	N/A

* The Advanced Systems Project was reinstated and the Ground Based Laser Technology was added as part of a major Program restructure conducted in the fall of CY 1986. Project 3647 will be transferred to PE 63605F, Advanced Radiation Technology, at the first opportunity.

2. (U) **BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED:** This program is developing and testing an antisatellite (ASAT) system in response to guidance contained in National Space Policy and the Secretary of Defense approved Mission Element Need Statement. This system is to deter Soviet ASAT attacks on critical US space systems, as well as to negate those Soviet space systems which would be used to target U.S. terrestrial forces, denying the Soviet's enhancement of their ability to destroy U.S. forces. The air-launched miniature vehicle (ALMV) ASAT currently under development consists of a modified Short Range Attack Missile (SRAM) first stage, an ALTAIR second stage, and a Miniature Vehicle warhead. ASAT missiles will be launched from designated, dual mission, air defense F-15s. To support ASAT testing, a dedicated target satellite (Instrumented Test Vehicle) has been developed. Altitude enhancements to the MV ASAT and development of ground-based laser (GBL) technology as an ASAT system are funded in this project.

3. (U) **COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)**

RDT&E	199,500	277,957	226,217	N/A	Continuing	N/A
Aircraft Procurement	0	0	4,700	N/A	Continuing	N/A
Missile Procurement	0	28,481	332,664	N/A	Continuing	N/A
Other Procurement	0	2,000	12,997	N/A	0	16,524

EXPLANATION: (U) In FY 1986, the $199,500 reflected in the FY 1987 Descriptive Summary assumed a reprogramming action which did not occur. In FY 1987, Congress reduced our RDT&E request by $78 million and deleted all procurement funding. Congress also reimposed the moratorium prohibiting testing against objects in space and restricted the implementation of the Production Verification (PV) effort. Due to these actions, a major program reevaluation was

conducted. The above changes reflect a restructured program which is described further in this descriptive summary.

4. **OTHER APPROPRIATION FUNDS: ($ in thousands)**

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Aircraft Procurement:						
Funds	33,700	0	0	33,900	110,695	186,895
Quantities						
Missile Procurement:						
Funds	0	0	21,800	364,539	Continuing	N/A
Quantities						
Other Procurement:						
Funds	0	0	8,540	0	0	8,540
Quantities		Not	Applicable			
Military Construction:						
Funds	0	0	16,000	0	0	16,000

5. (U) **RELATED ACTIVITIES:** This program is part of the Air Force Space Defense Systems Program effort involving four functional areas: Antisatellite (ASAT), Space Surveillance Technology, Satellite Systems Survivability, and Command and Control. Program Element 12311F, North American Aerospace Defense Cheyenne Mountain Complex - Space Defense System, is developing the space defense command and control segment which will interface with the ASAT system. Program Element 12424F, SPACETRACK, provides the necessary tracking capability and target catalog to support ASAT operations. Program Element 63605F, Advanced Radiation Technology, and the Strategic Defense Initiative Organization are developing the basic laser technology for potential ASAT applications.

6. (U) **WORK PERFORMED BY:** Air Force Systems Command's Space Division, Los Angeles, CA, manages this program. The Aerospace Corporation, El Segundo, CA, provides technical support. Air-launched ASAT major contractors are: Vought Corporation, Grand Prairie, TX; the Boeing Aerospace Company, Seattle, WA; AVCO, Wilmington, MA; and Logicon Corporation, Los Angeles, CA. Vought Corporation is developing the ASAT missile upper stage. Boeing Aerospace Company is developing the missile lower stage and the carrier aircraft equipment (pallet and pylon); AVCO is developing the Instrumented Test Vehicle (ITV); and Logicon is performing all software verification and validation. The Arnold Engineering Development Center and Air Force Systems Command Space and Missile Test Organization are both supporting the antisatellite (ASAT) development and test efforts.

7. (U) **PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:** Not Applicable.

8. (U) PROJECTS OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2134, Miniature Systems.

A. Project Description: This project funds the development and test of the Air-Launched Miniature Vehicle (ALMV) Antisatellite (ASAT) system, the Instrumented Test Vehicles (ITV), and enhancements to the ALMV. The ALMV ASAT weapon system has two elements, the ASAT missile and the carrier aircraft equipment (CAE). The first stage of the ASAT missile is a modified Short Range Attack Missile (SRAM). The second stage uses an ALTAIR motor for propulsion. The second stage contains a reaction control system (RCS) for attitude control, a missile guidance assembly (MGA), a cryogen system, and a miniature vehicle (MV)/dispenser. The MV, carried in the second stage, is the terminal warhead of the missile. The CAE, installed in modified F-15 aircraft, is used to carry, service, and launch the missile, and to provide the interface between the ASAT missile and the F-15 weapon control system. ITVs are required as orbital test targets to evaluate the effectiveness of the ALMV ASAT system. The target permits evaluation of the probability of kill. MV specifications call for a probability of kill (single shot) of [ ] The ITV is a six-and one-half foot diameter balloon-like satellite with a controllable Long Wavelength Infrared (LWIR) signature system (for simulating different Soviet targets) and miss distance and impact instrumentation. A total of ten ITVs will be launched on five Scout Boosters from the National Aeronautics and Space Administration (NASA) Wallops Flight Facility. The ITVs will be controlled by the Air Force Satellite Control Facility, Sunnyvale, California.

B. (U) Program Accomplishments and Future Efforts:

(1) FY 1986 Accomplishments: ASAT flight testing continued. Two ITVs were fabricated and delivered. Two development missiles were delivered. Two ITVs were successfully placed into orbits representative of various low-altitude threat satellites on 12 December 1985. Due to a Congressionally imposed moratorium prohibiting testing against objects in space, the test effort was restructured to conduct two infrared phenomenology tests against the radiation of a star. These tests were successfully completed on 22 August and 30 September. [

] These missions also demonstrated the capability of the MV to accomplish maximum duration free flight missions. Operations and control procedures refinements at the Prototype Mission Operations Center continued. An ASAT production verification (PV) effort was started. This effort was added to the development activities to provide an orderly transition to production.

(2) (U) FY 1987 Program: Due to FY 1987 Congressional actions, a complete reevaluation of the ASAT Program was conducted. This reassessment revalidated the seriousness of the Soviet threat and the requirement to achieve an operational ASAT capability as soon as possible. These led to the conclusion that the ALMV program must be continued. The ALMV is the only cost-effective system sufficiently developed which could be deployed in the needed time frame with high confidence. Further, to ensure that the Air Force takes maximum advantage of newer, more effective, and possibly less costly technologies, Strategic Defense Initiative (SDI) activities will be closely monitored and two additional demonstration efforts involving an increased altitude interceptor and a ground-based laser have been initiated. Two alternative approaches for the increased altitude interceptor will be studied. One will consider an

improved lower stage to replace the Short Range Attack Missile (SRAM). The second will evaluate the use of an existing booster (Pershing II, Trident, etc.) to ground launch the present upper stage and Miniature Vehicle (MV). Either of these approaches could increase the altitude capability of the MV Antisatellite (ASAT) by a factor of two to three. A decision will be made by the end of FY 1987 as to which approach should be explored further. The development and testing of the increased altitude interceptor is being funded under project 2135, Advanced Systems. The laser technology efforts are being jointly funded by project 3647, Ground Based Laser Technology, and the Strategic Defense Initiative (SDI) Program. The Air Force believes this is an arrangement which will benefit both organizations. In accordance with public law which prohibits testing against objects in space, no further live-fire missile flights are currently planned in FY 1987. Further, as directed by law, the Production Verification (PV) effort has been terminated. The revised FY 1987 Program consists of continuing the basic development program and incorporating/testing system improvements discovered earlier. Three development missiles will be delivered. One of the two Instrumented Test Vehicles (ITVs) launched in December 1985 was activated and checked out. The ITV performed extremely well. The remaining ITV on-orbit will be used as the target for the first intercept test planned in FY 1988.

(3) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The ASAT testing effort will continue. Three intercept tests are planned. The first will use the remaining ITV and the other two will use ITVs to be launched later in the year. The last six development missiles will be delivered. The PV effort will be restarted. PV is required to ensure that the system will be operable, producible, and supportable. Construction of the operational facility will begin at Langley Air Force Base (AFB), Virginia. Long-lead assemblies will be procured for the [ ] The Mission Control Center equipment will be procured. Cost estimates are based upon existing contract cost data, life-cycle cost data (updated by Program Office semiannually), and contractor estimates. Cost estimating category is III (Budgetary).

(4) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: ASAT testing and the PV effort will continue. Three upgraded missiles, developed under PV, will be delivered. Site activation at Langley AFB, VA will begin. [ ] Cost estimating category is III (Budgetary).

(5) Program to Completion: [ ] Four intercept tests will be conducted. [ ] Necessary engineering changes, identified in the test program, will be incorporated in the ASAT missiles. Improvements in operational supportability will continue. [ ] As the threat changes, new development efforts should be anticipated. The program office will conduct analyses of how to respond to various types of countermeasures the Soviets might attempt. This is a continuing program.

C. (U) Major Milestones:

		Milestones	Dates
(1)	(U)	ASAT Development Contract Award	June 1980
(2)	(U)	First Modified F-15 Available for Test	July 1982
(3)	(U)	First Missile Captive Flight Test	December 1982
(4)	(U)	MV/D Ground Tests Complete	January 1983
(5)	(U)	ITV Qualification Test Complete	June 1983
(6)	(U)	Missile Qualification Test Complete	October 1983
(7)	(U)	Point-in-Space Flight Test	January 1984
(8)	(U)	Infrared Probe Test	November 1984
(9)	(U)	Miniature Vehicle (MV) Qualification Test Complete	August 1985
(10)	(U)	First Intercept Flight Test	September 1985
(11)	(U)	First Instrumented Test Vehicle (ITV) On-Orbit	December 1985
(12)	(U)	Medium Altitude Infrared Probe Test	August 1986
(13)	(U)	Low Altitude Infrared Probe Test	September 1986
(14)	(U)	First Intercept of ITV	FY 1988
(15)			
(16)			

9. (U) PROJECTS OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2135, Advanced Systems.

A. Project Description: This project funds the development and test of an improved altitude capability starting in FY 1988 leading to a final deployment decision in[ ]. As described previously, the final configuration of the interceptor is still undergoing evaluation. It will, however, use the same upper stage (ALTAIR motor) and MV as the F-15 system but be launched from the ground using an existing booster or will employ an improved air-launched lower stage. A deployment decision as early as FY 1991 is enabled by the concurrent testing of the MV and upper stage under Project 2134. The interceptor will have the capability to negate enemy satellites[ ]

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Not Applicable.

(2) (U) FY 1987 Program: Not Applicable.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: In FY 1988, a development contract will

be awarded to begin development and testing of the selected improved altitude interceptor. Detailed operations and maintenance concepts will be developed. Design reviews will be conducted. Requalification testing of the ALTAIR and miniature vehicle (MV) will be performed, as necessary.

(4) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: [ ]

(5) Program to Completion: [ ]

C. (U) Major Milestones:

Milestones	Dates
(1) (U) Development Contract Award	FY 1988
(2) ( )	
(3) ( )	
(4) ( )	

10. (U) PROJECTS OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3647, Ground Based Laser Technology.

A. Project Description: This is a new project. This project develops and demonstrates the technology leading to a decision [ ] for the development of a large scale ground based laser (GBL) anti-satellite (ASAT) weapon. The goal is to demonstrate required technologies for: 1) the laser device, including scalability to higher power levels; 2) the supporting technology for the optical components; and 3) the required laser beam control technology to efficiently compensate and propagate the laser radiation through the atmosphere to a target in space. There will be two major near term demonstrations in the program: 1) a laser device module that is directly scalable to power levels required to meet ASAT requirements; and 2) an integrated up-link experiment to demonstrate the critical beam control and atmospheric compensation required for the mission.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Not Applicable.

(2) (U) FY 1987 Program: This project began in FY 1987 by continuing various Air Force and Strategic Defense Initiative Organization (SDIO) programs. The path for scaling up power levels will be continued in FY 1987 with [illegible] of the Excimer Mid Range Laser Development (EMRLD) and modification of an existing building at the High

Energy Laser System Test Facility (HELSTF) on White Sands Missile Range (WSMR), begun under Strategic Defense Initiative Organization (SDIO) funding, and the testing of the 25 kilowatt (kW) chemical oxygen-iodine laser (COIL) developed under PE 63605F, Advanced Radiation Technology. The development of improved oxygen generators for the oxygen-iodine laser will also begin in FY 1987. The development of high power optical components for these laser systems will build on small previous efforts or will pick up efforts that have been dropped by the SDIO. The critical elements are: aperture sharing elements that can transmit the short-wavelength lasers and receive radiation in the visible and long wavelength infrared (IR) bands (this is required so that the laser telescope can also be used to track the target); cooled deformable mirrors that have good optical performance and have the capability to remove the optical distortions at ultraviolet or short-wavelength IR; and other high power mirrors that have low absorption, with minimal disturbances due to coolant flow within the mirror. The major issues for these components are to settle on the most promising concepts and to develop fabrication technique for elements that can be manufactured on acceptable schedules and at affordable costs. In laser beam control, the driving issue for ground based lasers is the compensation of the optical distortion due to the atmosphere. Measurement of these effects will be continued from previous Air Force, Defense Advanced Research Projects Agency (DARPA), and SDI programs; compensation techniques will be designed based on concepts that have been proven at the laboratory level, and new techniques will also be explored that have the potential for being more robust. System level design and tradeoff studies will begin to define the parameters of the weapon system and examine the architecture, components and relative costs of the three candidate laser systems (excimer, oxygen-iodine, and Free-Electron Laser (FEL)). FEL device technology is funded solely by the SDIO, oxygen-iodine technology solely by the Air Force, and excimer device technology jointly by both.

(3) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: In FY 1988 the Excimer Mid Range Laser Development (EMRLD) laser build up will be completed and field installation will begin, the Chemical Oxygen-Iodine Laser (COIL) will be tested with a new oxygen generator concept, and laser power and beam quality tests will be run. Fabrication of demonstration units for low distortion high power mirrors, deformable mirrors, and an aperture sharing element will begin. In the beam control area, a closed loop experiment that demonstrates the sensing and correction of atmospheric turbulence will be performed on a 1.5 meter telescope. [

]

(4) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: [

]

(5) Program to Completion: [

]

C. (U) Major Milestones:

Milestones	Dates
(1) (U) Excimer Device Testing Start	FY 1988
(2) ( )	
(3) ( )	
(4) ( )	

11. (U) COOPERATIVE AGREEMENTS: Not Applicable.

Budget Activity: 3, Strategic Programs
Program Element: 64406F, Space Defense Systems

Test and Evaluation Data

1. (U) Development Test and Evaluation (DT&E): During FY 1984, antisatellite (ASAT) testing transitioned from mechanical fit checks and ground integration testing to aggressive captive and free flight testing. The main goal of this part of the program has been to corroborate analyses and ground test results through flight test in preparation for the first intercept. Flight testing is being conducted by the contractors, Air Force Western Test Range, Air Force Operational Test and Evaluation Center (AFOTEC), the Air Force Flight Test Center (AFFTC), the Air Force Satellite Control Facility (AFSCF), and Space Command.

(U) The lower stage (L/S) is a standard Short Range Attack Missile (SRAM) with modified control fins and electronics. All lower stages needed for flight test program have been identified from existing SRAM inventories. All pre-launch testing of lower stages has been completed. Free flight data analysis from the first five ASAT launches support ground test predictions of L/S performance.

(U) The upper stage (U/S) of the ASAT missile has completed qualification testing at both component and system levels. Major components include a Scout Altair Star 20B solid rocket motor, a modified F-16 inertial guidance platform, a reaction control system, and a cryogenic cooling system. The U/S also has instrumentation and flight termination systems used to support the flight test program requirements. Deliverable hardware is in stores. Under the production verification effort initiated in November 1985, design fixes are being incorporated to eliminate current operational, support, and producibility limitations and provide validation by the completion of the flight test program. First launch showed excellent performance of the U/S hardware and software to deliver a payload emulator to a predetermined point in space.

(U) Missile level qualification testing was completed in September 1983. Additionally, a modal survey was conducted on the assembled missile and the carrier aircraft equipment (CAE), and final ultimate load structural tests on the structural test missile were finished in November 1982. Free flight test results from the first five launches fully supported the ground test predictions of system performance.

(U) Component level testing of the miniature vehicle (MV) flight sensor assembly (FSA) was conducted in early FY 1981. This FSA performance demonstration showed that the sensor should meet performance requirements and that the two laser test method should adequately measure sensor performance. Testing of early production models of the sensor processing electronics (SPE) revealed excessive noise leading to electronics modifications. Another anomaly observed was the dielectric relaxation effect (DRE) being different than predicted. Mission simulations and actual flight data indicate that system accuracy can be preserved by selection of the proper detector operating conditions.

Budget Activity: 3, Strategic Programs
Program Element: 64406F, Space Defense Systems

Validation of the laser test method and characterization of the sensor's response to a "blackbody" source has been successfully completed at the Arnold Engineering Development Center (AEDC) since January 1984. Preliminary results are positive with a responsivity bias being the only significant difference from the laser test results noted thus far. Formal Miniature Vehicle (MV) qualification testing has been completed. Six of the eight parts of the testing (up to and including self-induced shock testing) was successfully completed by October 1984. In early November 1984, during the self-induced shock testing, one of the maneuver motors on the miniature vehicle burst. The cause of this failure has been determined to be undetected propellant cracks and debonds. A near term correction has been implemented and tested. A long-term fix will be implemented as part of a Pre-planned Product Improvement effort on all production missiles contingent on schedule and the appropriation of necessary funding. The first free flight test of an MV occurred on 13 November 1984 during the infrared probe (IRP) shot.

(U) The antisatellite (ASAT) Prototype Mission Operation Center (PMOC) calculates mission parameters used to guide and control an ASAT intercept against a selected target. The PMOC is located at the Cheyenne Mountain Complex (CMC) and is comprised of an IBM 4341 computer with relevant mission planning and communications software, communication links to Vandenberg and Edwards Air Force Bases, interfaces with the CMC Communications System Segment (CSS) and CMC Space Surveillance Center (SSC). There are two sets of IBM hardware; the primary set is located at the CMC, and certified backup is located at the Program Generation Center (PGC) in Seattle. The PMOC software developed by Boeing and Vought is now being utilized at the PMOC to provide the mission data loads for the ASAT captive and free flight tests at Edwards AFB. PMOC support of captive and free flight testing has been outstanding and is presently part of the ASAT/Mission Control Segment (MCS)/instrumented tests vehicle (ITV) integration testing efforts.

(U) The ASAT flight test program is designed to be a combined Development Test and Evaluation and an Initial Operational Test and Evaluation (DT&E/IOT&E) program. It is comprised of an interlaced series of captive carry flight tests and live-fire (free) flight tests. Captive carry tests began in mid-December 1982 with a total of 125 hours of flight tests planned. Five of the twelve planned live-fire launches have been completed.

(U) A captive flight test missile (CFTM) has been fabricated for the captive carry flight program. This missile is functionally equivalent to the flight test missile (FTM). In the CFTM, the MV is replaced by an emulator which has the same mass properties and electrical interfaces as an actual MV. CFTM pyrotechnics and propulsion are inert. The CFTM is presently in captive flight testing. Tests and procedures developed for the CFTM are directly applied to assembly and checkout of the FTMs procured for the program.

(U) The captive carry flight program objectives are the assessment of F-15 performance while mated with the ASAT missile, evaluation of the navigation function of the missile, evaluation of the pilot/ASAT system interaction, and assurance of test range readiness for live-fire launches. The captive carry program has successfully demonstrated adequate F-15/ASAT launch performance, range metric and telemetry coverage, range safety command and control, and system navigation functions. Pilot/ASAT interaction tests have identified areas for improvement in waypoint steering capabilities and supersonic launch performance. These remaining areas are being worked to support the first instrumented test vehicle (ITV) intercept and first supersonic launch requirement.

Extensive planning is in progress for the nine remaining live-fire missile tests. The first live-fire flight test, with the basic upper and lower stages of the missile and an [ ] was completed successfully on 21 January 1984. The objective of this test was to evaluate the capability of the system to deliver a miniature vehicle (MV) to a specific point in space (PINS) at a designated time. This test was also used to verify the capabilities of the Western Test Range (WTR) at Vandenberg AFB to support data acquisition during subsequent tests.

The second antisatellite (ASAT) flight, an infrared probe (IRP) test, was launched on 13 November 1984. The primary objective of the test was to demonstrate the capability of the miniature vehicle (MV) to acquire and track a fixed infrared-emitting object, in this instance, a star. The test was also designed to reaffirm the performance of the first and second stage propulsion systems, the missile guidance system, upper stage pointing functions, spin-up and deployment of the MV. The missile performed as planned and delivered the upper stage to a predetermined point in space. [ ] While not all test objectives were achieved, sufficient data were gathered to allow the test program to proceed to the next phase, the intercept tests.

The third ASAT flight, the first intercept test against an object in space, was successfully completed on 13 September 1985. The aircraft, missile, and software all performed as planned. An old Air Force experimental satellite (P78-1), past its useful life, was destroyed at [ ] The original plan was to use an instrumented test vehicle (ITV) as the target. However, a problem in the ITV's command receivers, which has been since corrected, resulted in a delay. Since a test against an old satellite (test #7 in test matrix) had always been planned, the schedule was rearranged so the program could continue. [ ] The first two ITV's were launched from the NASA Wallops Island facility on 12 December 1985.

(U) Due to a congressional restriction in the Final FY 1986 Appropriations Bill which prohibits testing against objects in space, the entire testing effort was revised. Prior to enactment of the restriction, two intercepts and a low altitude infrared phenomenology test were planned. The revised FY 1986 test plan consisted of two infrared phenomenology tests to demonstrate the performance of the Miniature Vehicle (MV) at low earth altitudes.

The fourth ASAT test was successfully conducted on 22 August 1986 [ ] Extensive data was collected on the MV sensor. Two specific effects, MV rocket plumes and the earth limb radiation, [ ] Current analyses indicate that the rocket plume and earth limb radiation effects were as predicted and are within acceptable bounds. The fifth ASAT test was also successfully completed on 30 September 1986. Extensive information was obtained at a lower earth altitude [ ] Again, both the plume and earth limb radiation effects were as predicted and are within acceptable limits of the sensor.

(U) With the success of both tests in FY 1986, we were proceeding with a plan to conduct three intercepts in FY 1987. However, Congress reimposed the testing moratorium another year. Our near-term activities have been revised

and no live fire missile tests are currently being planned in FY 1987. Live fire missile testing will begin in FY 1988 with three intercepts against instrumented test vehicles (ITVs). In December 1986, one of the two ITVs launched on 12 December 1985 was successfully activated from its stored configuration. Subsequent tests verified that the ITV met or exceeded all design requirements. No problems or anomalies were identified.

2. (U) Operational Test and Evaluation (OT&E): The Air Force Operational Test and Evaluation Center (AFOTEC) initial operational test and evaluation (IOT&E) of the ASAT system began with the combined development test and evaluation (DT&E)/IOT&E flight tests in late CY 1983. DT&E and IOT&E objectives were to be addressed in the planned interception of eight ITV satellites and one remaining resident space object (RSO). However, due to the FY 1986 Congressional restriction, the flight test program has been revised to include seven intercepts. We hope to conduct one of these against an RSO below 150 nautical miles. This will be contingent on the availability of RSOs. However, because of the very limited availability of RSOs and the need for a test target with variable infrared signature and missed distance scoring, the ITV will be the primary test satellite. The first threat representative RSO target to be identified was P78-1 (an old Air Force experimental satellite). DT&E objective are primary on the initial flights, and IOT&E objectives primary on the later flights.

(U) The development test and evaluation (DT&E)/initial operational test and evaluation (IOT&E), conducted at Edwards AFB, California by the 6510th Test Wing and the Air Force Operational Test and Evaluation Center (AFOTEC), is addressing the weapon segment (missile, F-15, and associated support equipment). The IOT&E objectives for the surveillance, command, and control segments (Prototype Mission Operationa Center and targeting data from the Space Surveillance Network) are being addressed by AFOTEC and Space Command personnel at the Cheyenne Mountain Complex. The contractor will operate and maintain the system during the test program.

(U) A production verification effort was added to the ongoing development program in November 1985 to provide an orderly and comprehensive transition from development to production. Additional flight test missiles will be procured to augment the current program. At least two major modification blocks will be incorporated into these missiles to meet operational requirements. Based upon data gathered to date, changes incorporated in the first modification block will include hardware to allow flight line vacuum servicing of the flight sensor assembly (FSA), expansion of the missile guidance assembly (MGA) capability, and a higher capacity battery for the guidance processor electronics (GPE). A later modification block will add the changes necessary for improved missile testability, removal of permanent test instrumentation and substitution of an add-on kit, and redesign of the sensor processing electronics (SPE). These modifications will be demonstrated by ground and flight tests.

(U) Support equipment will also be developed in conjunction with the additional missiles. This equipment will be used to demonstrate the reliability and maintainability of the missiles and carrier aircraft equipment (CAE).

The system's capability]

Budget Activity: 3, Strategic Programs
Program Element: 64406F, Space Defense Systems

(U) Over 45 captive-carry flight tests, one flight test to a point in space, three infrared probe tests, and a successful intercept test have been completed to date. Evaluation of the system's performance began with the first flight test and continued through the last infrared probe test. The intercept flight provided operational representative data inputs because a realistic target satellite (not the Instrumented Test Vehicle (ITV)) was used as a target. Data from all testing is evaluated for input to AFOTEC's operational effectiveness model data base. System deficiencies have been identified to the program office and fixes are being reviewed by them.

(U) Because of the Congressional moratorium prohibiting testing against objects in space, the IOT&E of the anti-satellite (ASAT) system is proceeding in a very limited fashion. Over half of the IOT&E objectives require live-fires against an actual target satellite (either an ITV or a resident space object (RSO)) to evaluate those objectives.

3. (U) System Characteristics:

(U) System Performance and Supportability:

Characteristic	Objective/Threshold	Demonstrated	Method
- Probability of Kill (single shot)		-	DT&E/IOT&E Flight Test
- Effectiveness[1]		-	DT&E/IOT&E Flight Test
- Altitude Capability			
-- High[2]		-	DT&E/IOT&E Flight Test
-- Low[3]		-	DT&E/IOT&E Flight Test
- Mean Time Between Maintenance Actions		-	IOT&E/FOT&E Test
- Mean Time to Repair (Organization Level)	4* hours/TBD	-	IOT&E/FOT&E Test
- Mean Time to Repair (Intermediate Level)	12* hours/TBD	-	IOT&E/FOT&E Test
- Fault Isolate	0.5* hours/TBD	-	IOT&E/FOT&E Test
- Ready Alert[4]		-	IOT&E/FOT&E Test
- Preflight		-	IOT&E/FOT&E Test

* Goal at Full Operational Capability (FOC)
† Goal at Limited Capability (LC)
1 Effectiveness is the expected probability of negation of each of the priority 1 and 2 targets within 24 hours.
2 The high altitude capability shown is the mean value minus 3 sigma at a missile range of 100 nautical miles.
3 The low altitude capability will be determined by analysis if no suitable resident space objects can be identified.
4 Ready alert is the period the antisatellite (ASAT) system can stand ready to negate required targets.

Budget Activity: 3, Strategic Programs
Program Element: 64406F, Space Defense Systems

(U) Subsystem Characteristics: Prototype Flight Test Missile (PFTM)

(U) First Stage: Standard Short Range Attack Missile plus ASAT modifications including two fixed fins, three modified variable fins, and flight control electronics.

(U) Characteristic		Objective/Threshold	Demonstrated	Method
- Weight (total)	(Pounds)	1723/1750	1714	DT&E Measurement
- Thrust	(Pounds)	7511/TBD	7511	DT&E Ground Test
- Temperature	(Degrees Fahrenheit)	-65 to +145°/TBD	-65 to +145°	DT&E Environmental Test
- Total Impulse	(Pound-Seconds)	255,000/TBD	255,000	DT&E Ground Test

(U) Second Stage: Standard ALTAIR III with minor structural modifications, reaction control system, and missile guidance assembly. Weight is as attached to lower stage prior to flight and includes miniature vehicle dispenser.

(U) Characteristic		Objective/Threshold	Demonstrated	Method
- Weight (total)	(Pounds)	983/1013	1003	DT&E Measurement
- Thrust	(Pounds)	5650/To Be Determined (TBD)	5650	DT&E Ground Test
- Temperature	(Degrees Fahrenheit)	-40 to +100°/TBD	-40 to +100°	DT&E Ground Test
- Total Impulse	(Pound-Seconds)	173,000/TBD	173,000	DT&E Ground Test

Miniature Vehicle:

- Sensor	(Long Wavelength Infrared)			
- Weight	(Pounds)	TBD		DT&E Measurement
- Dimensions	(Inches)	TBD		DT&E Measurement
- Destruct Mechanism		Hypervelocity		DT&E Flight Test

4. Current Test and Evaluation (T&E):

T&E Activity (Past 12 Months)

Event	Planned Activity	Actual Date	Remarks
C^3 Demonstration	3nd Qtr FY 1986	27 May 1986	First exercise to demonstrate C^3 capabilities of antisatellite (ASAT) agencies in the Cheyenne Mountain Complex (CMC).
ASAT Live-Fire Medium Altitude Infrared Probe	Not Applicable. Program revised due to Congressional restriction.	22 Aug 1986	Special test to gather data of Miniature Vehicle's (MV) performance at [ ]
C^3 Demonstration	4th Qtr FY 1986	23-25 Sep 1986	Second exercise to demonstrate a larger portion of the ASAT C^3 chain. Agencies outside of CMC and decisions by a USSPACECOM battle manager were included.
ASAT Live-Fire Low Altitude Infrared Probe	4th Qtr FY 1986	30 Sep 1986	Special test to gather data of MV's performance at [ ]
Instrumented test vehicle (ITV) activation/characterization mission	1st Qtr FY 1987	17 Dec 1986 - 25 Jan 1987	Test originally planned as part of the first intercept mission. Test was extremely successful and demonstrated ITV's performance.

Budget Activity: 3, Strategic Programs
Program Element: 64406F, Space Defense Systems

T&E Activity (Next 12 Months)

Event	Planned Date	Remarks
First DT&E/IOT&E instrumented target vehicle (ITV) intercept		Congress has reimposed testing restriction for FY 1987. Test has been delayed until FY 1988.
Second DT&E/IOT&E ITV intercept		Test has been delayed until FY 1988.
Third DT&E/IOT&E ITV intercept		Test has been delayed until FY 1988.

FY 1988/1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64711F
DOD Mission Area: 113 - Airborne Strike

Title: Systems Survivability (Nuclear Effects)
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Estimate	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		11,227	13,061	12,976	11,340	Continuing	N/A
2485	S/V Assessment of Ground C^3 Systems	3,500	1,400	0	0	Continuing	N/A
3429	B-1B EMP Test	0	4,500	8,076	5,340	Continuing	20,616
3763	S/V Assessment of Aerospace Systems	7,727	7,161	4,900	6,000	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Develops and demonstrates the engineering capability required for high confidence verification, hardening, and maintenance of Air Force and DOD aerospace aircraft, missiles, and command, control, and communications (C^3) systems which must operate and survive in a nuclear environment. Funds the Electromagnetic Pulse (EMP) Design Verification Test of the B-1B. Determines through analysis and testing the survivability/vulnerability (S/V) of Air Force and DOD aerospace and C^3 systems and associated structures to nuclear effects Establishes EMP standards and specifications for Air Force and DOD programs. Areas this program supports are: strategic bombers, tactical fighters, airlift, missiles, theater installations, and C^3. The nature of threat to Air Force system requires that they be able to operate in a variety of nuclear environments. To insure system survivability in these environments, the Air Force needs hardening materials, analytical techniques, and test methods to develop reliable, cost-effective hardening techniques and to verify/assess system hardness.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY ($ in thousands):

RDT&E	7,725	13,515	19,650	9,292	Continuing	N/A

EXPLANATION: (U) Undistributed cuts in FY 1988 of $2.4 million and in FY 1989 of $1.8 million were to meet fiscal guidance. Approximately $4.0 million for the B-1B EMP Test moved from FY 1988 to FY 1989 to meet fiscal guidance.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: This program is related to Air Force programs which develop and maintain a survivable strategic force with associated command and control communications systems. Related programs are: PE 64711F/Project 1209, Nuclear Effects Simulation Test Facilities; PE 63605/Project 3277, Aeronautical and Missile System Survivability; PE 63605/Project 3278, Ground-based System Survivability; PE 62601F/Project 8809, Nuclear S/V Technology; PE71111F,

PE: 64711F

Aircraft and C3I S/V Maintenance. Test facilities for this program are acquired under PE 64747F/Project 1209. A joint working group between the Air Force, the Defense Communications Agency, and the Defense Nuclear Agency has been established to coordinate command, control, and communications (C^3) assessment plans and to effect timely exchange of results. USDRE has established a joint Defense Nuclear Agency (DNA)/Multi-agency Cooperative Electromagnetic Pulse (EMP Hardening Technology Program to coordinate the efforts of DNA and the services in developing EMP hardening technology, and has established a Military Standardization and Specifications for EMP Program to develop EMP standards and specifications in accordance with the Defense Standards and Specifications Program.

6. (U) WORK PERFORMED BY: The program is managed by the Air Force Weapons Laboratory, Kirtland AFB, NM, except for the B-1B EMP test managed by Aeronautical Systems Division B-1B System Program Office. The top five contractors are: UNM NMERI, Albuquerque, NM (Project 3763); Dikewood Corporation, Albuquerque, NM (Project 3763); TRW, Albuquerque, NM (Project 3763); Mission Research Corporation, Santa Barbara, CA (Project 2485); RDA, Albuquerque, NM (Project 2485). A total of seven additional contractors hold contracts worth approximately $39,000,000.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 3763, S/V Assessment of Aerospace Systems. This project develops and validates advanced nuclear hardening techniques and nuclear hardness maintenance/hardness surveillance (HM/HS) techniques for aircraft, missiles, and associated structures. This project also determines by analysis and testing the nuclear survivability/vulnerability (S/V) of these systems and transfers hardening technology and S/V assessment techniques to product divisions and operating commands. During FY 1986, development of system-level EMP standards and specifications for aircraft as directed by DOD was begun and verification testing of sub-system-level specifications was performed on the EMP Test Aircraft (EMPTAC). The Mobile Universal Direct Drive for EMP simulation, developed and built under this project, began testing on weapons systems. This testing system injects EMP-like currents directly into cables and connectors on survivable systems to determine the response of subsystems to current transmitted through the weapon system cables and antennas. Initial development of Hardness Assurance Monitoring System (HAMS) technology, required to support life-cycle nuclear hardness maintenance, to detect and locate hardness was started. degradation. Experiments were completed on the EMPTAC to characterize high power EMP testing and correlate to low power direct drive testing. Development of the EMPTAC shield and cable tester and the Modular Data System (MDS) for real time data recording and processing were completed. The development of blast and shock resistance structures utilizing Slurry Infiltrated Fiber Reinforced Concrete (SIFCON) will continue. SIFCON testing indicated that the material, developed under this project, is a significant improvement over reinforced concrete. This material has been shown to be five times stronger and 20 times tougher than conventional reinforced concrete. Additional efforts include: zinc oxide transient protection device testing completed; EMP Data Acquisition System (DAS) design and checkout completed; Probabilistic Assessment of Strategic Structural Systems (PASS) code applications performed; PASS code applied to vertical missile silo designs; and direct measurement of nuclear-induced strain in cables and pipes and field testing of water and petroleum pipelines begun. In FY 1987, EMPTAC will be used as a testbed to prepare for the B-1B EMP Test and to test the HAMS, MDS, Shielded Cable Tester, On Board Upset and the EMPTAC support laboratory. Development of system-level EMP standards and specifications for aircraft will continue. Development of HAMS technology will continue and include testing on EMPTAC. In FY 1988 and 1989, improved EMP testing techniques will be exercised and verified. The development of

analysis techniques for the response of strategic structures to blast, including missile silos, will be continued. Hardness maintenance/hardness surveillance (HM/HS) testing plans will be developed for the B-1B, EC-135, and E-4B as they were EMPTAC. In FY 1988 and 1989, improved EMP testing techniques will be exercised and verified. The development of analysis techniques for the response of strategic structures to blast, including missile silos, will be continued. Hardness maintenance/hardness surveillance testing plans will be developed for the B-1B, EC-135, and E-4B as they were for the E-3A. Advanced technology for hardening and testing will begin in several areas. A SIFCON test object will be fabricated and tested. The HAMS testing on EMPTAC will be completed. Additional efforts include: DAS enhancement for B-1B testing will be completed; begin underground storage tank and electric substation survivability studies; and begin composite and fiber optics hardening technology development. The requirements to support survivability issues are continuing.

B. (U) Project: 3429, B-1B Test. This project funds an Electromagnetic Pulse Design Verification Test of the B-1B. Objectives of the test are to: verify EMP design specifications, design implementation, and safety margins; establish an HM/HS baseline for the B-1B maintenance concept; and provide data to evaluate hardening for future aircraft. During 1986, the test concept document was completed and approved. Detailed test planning for Phase I and Phase II began. In FY 1987, Phase I of the B-1B Electromagnetic Pulse (EMP) Design Verification Test (EMP/DVT) will be accomplished on a B-1B in the field at Ellsworth Air Force Base or the Air Force Weapons Laboratory. This testing survey will provide data for instrumentation development and calibration and test point selection to support the primary system-level Phase II test in 1988. In FY 1988, Phase II of the B-1B EMP Design Verification Test will be a systems-level EMP test accomplished on a B-1B production model at Kirtland Air Force Base. This test will verify the EMP design integrity and correlate high power system response with low power tests for the aircraft's hardness maintenance baseline program. The estimated costs are based on past program experience, adjustment for expected cost growth, and projected man-hours to perform the above projects in a competitive environment. In FY 89, test data will be analyzed and the results compared to the test objectives. Plans for a FY 1990 retest to look for system degradations during operation and maintenance will be completed. The same aircraft used during Phase II will be tested in FY 1990 and the test results will be compared to the FY 1988 data to develop the hardness surveillance profile.

8. (U) PROJECTS OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 11142F
DOD Mission Area: 113 - Airborne Strike

Title: KC-135 Squadrons
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		226	3,708	4,035	4,179	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The IARS program is designed to fund several research and development projects that will improve the aerial refueling system and thereby enhance the capability of the 1950 designed KC-135 fleet. The requirement for this program was established by the Strategic Air Command in their Required Operational Capability 1-77 (validated September 1980) which identified deficiencies in fuel pressure regulation, fuel offload rates, disconnect capability, boom control authority, probe and drogue refueling equipment, and boom operator's station equipment. The IARS program is phased over the years to investigate system changes to alleviate deficiencies, improve the overall refueling capability of the aircraft and enhance inter- and intra- service and NATO aerial refueling procedures.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	944	3,941	4,153	N/A	Continuing	N/A

(U) EXPLANATION: The FY 86 reduction reflects reprogramming actions. The FY 87 reduction is a result of a Congressional funding reduction and the FY 88 figure reflects an adjustment for revised inflation indices.

4. (U) OTHER APPROPRIATION FUNDS: Not applicable

5. (U) RELATED ACTIVITIES: Not applicable

6. (U) WORK PERFORMED BY: The primary contractors: J.C. Carter Co., Costa Mesa, CA; Sargent Fletcher Co., El Monte, CA; XAR Industries, City of Industries, CA; and Dataproducts New England, Inc., Wallingford, CN. The in-house developing organizations: Air Force Systems Command's Aeronautical Systems Division, Wright-Patterson AFB, OH; 4950th Test Wing, Wright-Patterson AFB, OH; and 6150th Test Wing, Edwards AFB, CA.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2214, Improved Aerial Refueling Systems (IARS)

A. (U) Project Description: The purpose of the IARS program is to investigate a number of projects which are designed to improve the aerial capability of the KC-135 aircraft. IARS projects improve night aerial refueling capability and correct deficiencies in fuel pressure regulation, fuel offload rates, disconnect capability, boom control authority, probe and drogue refueling equipment, and boom operator station equipment. The air refueling nozzle program incorporates disconnect capability independent of receiver aircraft systems and sensors to alleviate stress loading on the boom during air refueling contact. The project also pursues improvements to the air refueling boom to provide increased boom control authority for an expanded air refueling "envelope" (area in which the receiver can maneuver while hooked up to the boom). These efforts will help eliminate brute force disconnects and nozzle/receptacle binding, reduce receiver pilot fatigue, and enhance safety by expanding the limits of the envelope. Additionally, work is being done to compile aerial refueling data from all DOD aerial refueling users and contractors. This consolidated information will be published in a performance interface document that will enhance aerial refueling procedures. The IARS program is vital to improve the 1950's technology of the KC-135's aerial refueling system and to make sure the aircraft is capable of continuing to meet its worldwide refueling requirements.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Aeronautical Systems Division completed the testing of the aerial refueling support equipment. This initiative has developed equipment to provide on-the-ground pressure testing of both boom and nozzle and hose and drogue systems. Equipment to test rotation and deflection of the boom nozzle has also been developed. The major emphasis of the program was to investigate purchasing the reprocurement package with Level III drawings in preparation for procurement of the support equipment. Additional work included further design/development of an air refueling boom with improved boom control authority. These efforts will help eliminate brute force disconnect and nozzle/receptacle binding, reduce receiver pilot fatigue, and enhance safety by expanding the limits of the envelope.

(2) (U) FY 1987 Program: There are several projects being worked in FY 1987. The first is completion of the performance interface document. This document, when published, will provide a consolidated reference for air refueling users, both tankers and receivers. The second project is the boom nozzle lighting program. This program will upgrade the present boom nozzle light and install a second light to increase illumination and add redundancy. Service test and evaluation will be performed by installing this dual lighting system on one (1) squadron of KC-135s. Night refueling data will be collected over a 6 month period and it will be compared to similar data from a KC-135 squadron not equipped with the improved nozzle lighting. The final project for FY 1987 is to complete development of an improved nozzle. Each contractor's nozzle will be installed on 5 KC-135s for a service test and evaluation. Data will be collected from the test and a final nozzle recommendation made.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Finalize the improved nozzle and boom assembly design and begin construction of a prototype. This equipment will be tested by the government. Laboratory testing, at a cost of over $100,000 will be followed by aircraft ground tests on a modified Air Force Systems Command KC-135. The Class II modification, based on similar work in 1982-83, and tests are estimated to cost approximately $500,000. The remaining money is required to continue initiation of design/development of an air refueling boom with improved boom control authority. The FY 1988 program will work on developing an improved

aerial refueling boom which incorporates an independent nozzle disconnect system, improved boom nozzle lighting (including redundant systems with variable intensity) and improved boom control in pitch and azimuth (including trim to relieve operator fatigue). This will include a tanker-initiated independent aerial refueling nozzle disconnect capability to release the boom nozzle from the receiver aerial refueling system (receptacle). The improved nozzle flight testing, test report, and demodification will be completed. A design study will begin for a suitable location on the KC-135 wing for the pod-mounted hose/reel probe and drogue system. The pod system permits the KC-135 to refuel with either a probe and drogue or a boom system. Additionally, initial design for the installation of a new KC-135 aerial refueling receptacle will also begin.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The FY1989 program will continue development and testing of the improved boom and nozzle assembly. Development of a pod-mounted hose/reel drogue aerial refueling system will be continued with flight testing to begin in 1990.

(5) (U) Program to Completion: The IARS program is a continuing effort of individual projects that will not only improve the KC-135's air refueling system, but also advance technology for future applications in this mission area. Future years' efforts include: design and installation of a prototype air refueling receptacle for the KC-135, testing of boom operator station improvements, development of pod-mounted hose/reel probe and drogue system, and development of a boom-configured multi-point aerial refueling system.

C. (U) Major Milestones:

Milestones	Dates
(1) (U) Improved Boom nozzle lighting	
IOC	2nd Quarter FY 1988
(2) (U) Improved nozzle	
IOC	3rd Quarter FY 1988
(3) (U) Multi-point hose reel	
IOC	2nd Quarter FY 1989
(4) (U) Improved boom	
IOC	3rd Quarter FY 1989
(5) (U) Boom operator station improvements (ADDED)	
IOC	3rd Quarter FY 1989

(U) Explanation of Milestone Changes: Milestones subdivided and reordered as a result of a reprioritization of requirements by SAC. IOC dates are included because the procurement schedule is not firm. Milestone 5 has been added to comply with the requirements in SAC ROC 1-77.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

Budget Activity: 3, Strategic Programs
Program Element: 11142F, KC-135R Modernization Program

Test and Evaluation Data

1. (U) Development Test and Evaluation (DT&E): DT&E for the KC-135R was combined with part of the operational test and evaluation (OT&E) program. Combined DT&E/OT&E was conducted at Wichita, Kansas, and Edwards AFB, California, from 4 August 1982 to 5 April 1984. The test aircraft flew 77 DT&E/OT&E sorties at Edwards and was evaluated for two months in the climatic laboratory at Eglin AFB, Florida. All elements of the more than 25 updated systems were evaluated with the exception of production engine struts and nacelles, which were installed before the aircraft was delivered to Strategic Air Command on 29 June 1984. Lack of production struts and nacelles had no impact on the DT&E/OT&E program.

(U) No major discrepancies were found during DT&E/OT&E. Because the quick start/auxiliary power unit system (QSAS) was the last system installed, limited time was available for QSAS testing. There was insufficient time in the planned test program to incorporate and retest changes mandated by QSAS service reports, so the QSAS was rated undetermined in the final DT&E/OT&E test report. Major areas of concern with the QSAS were slower start times at temperatures above 90F and with strong, gusting, left quartering tailwinds. Those areas were tested by Strategic Air Command during follow-on test and evaluation (FOT&E).

(U) The test team rated the KC-135R's performance, handling, and aerial refueling excellent, reflecting significant improvements over the KC-135A. Mission capability was enhanced by the new and modified systems. Availability, reliability were rated satisfactory, with the engine showing the most improvement. Engine logistics reliability for the KC-135R was three times better than the KC-135A; engine system maintainability showed a fivefold improvement.

	KC-135A	KC-135R
Availability		
Full Mission Capable	89.1%	89.1%
Mission Capable Rate	90.8%	95.0%
Reliability		
Mission Effectiveness	95.8%	98.0%
Mean time between maintenance (inherent)	1.2 hours	2.2 hours
Mean time between maintenance (corrective)	0.7 hours	0.7 hours
Maintainability		
Man-hours per flight hour	5.9 hours	3.1 hours
Mean man-hours to repair	3.9 hours	4.1 hours

Budget Activity: 3, Strategic Programs
Program Element: 11142F, KC-135R Modernization Program

(U) NOTE: Mean man-hours to repair for the KC-135R were driven by time required to repair cracks in airframe panels and engine struts early in the test program and by adjustments to the high speed trim modification to the autopilot. The cracks were peculiar to the KC-135A airframe used for the KC-135R test bed. The autopilot modification was subsequently deleted from production aircraft.

(U) The KC-135R Program Office, Aeronautical Systems Division, Air Force Systems Command (AFSC), Wright-Patterson AFB, Ohio, was the program manager. Boeing Military Airplane Company, Wichita, Kansas, was prime development contractor. AFSC was responsible for DT&E. The combined DT&E/OT&E team was made up of representatives from the Air Force Flight Test Center, Air Force Operational Test and Evaluation Center, Strategic Air Command (SAC), Air Force Logistics Command, and Air Training Command.

2. (U) Operational Test and Evaluation (OT&E):

(U) The Strategic Air Command continues to conduct Follow-on Operational Test and Evaluation (FOT&E) of the re-engined KC-135, designated the KC-135R. All tests are being conducted by the 384th Air Refueling Wing, Directorate of Training (AREFW/DOTZ), McConnell AFB, Kansas. A final report on KC-135R FOT&E was published in October 1985, titled, SAC Project 1415 KC-135R Follow-on Operational Test and Evaluation Final Report Revision 1, encompassing the test period 1 July 1984 to 30 June 1985. The report rated the KC-135R weapon system satisfactory with marked improvement in many operational capabilities over the KC-135A. Improvement in base escape time and increased engine performance and efficiency were the most notable areas. However, several areas remained "undetermined" or "deficient" at the end of this FOT&E period. These areas were:

(U) The capability of the KC-135R to operate normally in a cold weather environment was rated deficient. During cold weather evaluation, fuel/oil heat exchanger and fuel servo heater units developed leaks at -10 degrees F. An enhanced seal was manufactured and retrofitted. Further testing of this seal was recommended in the final report.

(U) The reliability and maintainability of the Quick Start/Auxiliary Power Unit System (QSAS) and Environmental Control System (ECS) were labeled undetermined. This was due to the low baseline rates reflecting that logistics support was lagging behind aircraft deliveries.

(U) Due to these factors, SAC directed an additional test period from 1 January 1986 to 30 June 1986 to further evaluate these areas. The reliability and maintainability of the QSAS and ECS was reported in Jul 86 with considerable improvement in all areas indicated. The cold weather test was scheduled for 27 January 1986 to 2 February 1986, however, unseasonably warm temperatures at the test location resulted in postponement of the test. Because of the unpredictability of the weather, the McKinley Climatic Hangar was sought in order to complete the cold weather test in a timely manner. To meet the Climatic Hangar test schedule, SAC extended the test period to 1 January 1987. Presently, cold weather testing is scheduled at the hangar from 5 October 1986 to 10 November 1986.

Budget Activity: 3, Strategic Programs
Program Element: 11142F, KC-135R Modernization Program

3. (U) System Characteristics:

Characteristic	Objective/Threshold	Demonstrated
Maximum takeoff gross weight	322,500 lbs	322,500 lbs
Fuel capacity	203,000 lbs	203,288 lbs
Takeoff ground roll (90F, sea level, air conditioning on)	9,000 ft	8,100 ft
Critical field length (90F, sea level, air conditioning on)	11,000 ft	10,400 ft
Fuel savings	25%	27%
Engine noise	106 decibels	97 decibels

Budget Activity: 3. Strategic Programs
Program Element: 11142F, KC-135R Modernization Program

4. (U) Current Test and Evaluation (T&E):

FOT&E Activity (Past 12 Months)

Event	Planned Activity	Actual Date	Remarks
Cold Weather Test	27 Jan 86 to 2 Feb 86	Postponed	Unseasonably warm temperatures encountered.
QSAS/ECS	1 Jan 86 to 30 Jun 86	1 Jan 86 to 30 Jun 86	Results will be forwarded in addendum.
Cold Weather Test	5 Oct 86 to 10 Nov 86	5 Oct 86 to 10 Nov 86	Results will be forwarded in addendum.

FOT&E Activity (Next 12 Months)

Event	Planned Date	Remarks
Extended FOT&E Completion	1 Jan 87	Strategic Air Command (SAC), directed
Addendum to Test Plan Complete	10 Feb 87	Office of Primary Responsibility is Headquarters, Strategic Air Command Director of Operations

NOTE: Tests depicted in this schedule are sorties/tests for specific test objectives and do not outline the numerous sorties/tests conducted by the KC-135R supporting general test objectives.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 11213F
DOD Mission Area: 111 - Land-Based Strike

Title: Minuteman Squadrons
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		4,796	48,333	107,672	199,615	Continuing	N/A
133B	Minuteman Squadrons	4,796	12,970	30,531	69,430	Continuing	N/A
3626	Minuteman III Pen Aids	0	35,363	77,141	130,185	103,565	367,520

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Minuteman weapon system became operational in the 1960s and now consists of 450 Minuteman II and 550 Minuteman III (50 to be replaced by Peacekeeper) intercontinental ballistic missiles (ICBMs) deployed in hardened underground silos. Minuteman has served as a prime nuclear deterrent force for the United States for 24 years and is projected to maintain this role into the next century. This program element provides improvements and modifications to the Minuteman force to enhance its contribution to strategic deterrence.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	5,511	67,526	221,921	N/A	Continuing	N/A
Missile Procurement	0	0	0	N/A	753,090	753,090
Other Procurement	0	0	0	N/A	3,330	3,330

EXPLANATION: (U) Decrease in RDT&E funding in FY 1986 (-$715 thousand) was due to inflationary and Gramm-Rudman adjustments. RDT&E reduction in FY 1987 reflects Congressional action to delay the ICBM Integrated Electronics program while a more complete definition of the program was developed (-$17.526 million) and inflationary adjustments (-$1.667 million). The RDT&E reduction in FY 1988 was caused by a restructure of the ICBM Integrated Electronics Program combining the Launch Control Center Integration, Computer Aided Message Processing and Minuteman II Flexible Targeting programs into a single program (-$94.084 million), by the delayed start of the Minuteman III Penetration Aids Program (-$15.7 million) and inflationary adjustments (-$4.465 million). The Total Estimated Cost for Missile Procurement was also reduced (-$65.98 million) due to the restructure of the ICBM Integrated Electronics Program.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

Missile Procurement (ICBM Integrated Electronics):						
Funds	0	0	0	0	416,100	416,100
Quantities	0	0	0	0	135	135

Program Element: 11213F
DOD Mission Area: 111 - Land-Based Strike

Title: Minuteman Squadrons
Budget Activity: 3 - Strategic Programs

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Missile Procurement (Penetration Aids):						
Funds	0	0	0	0	271,010	271,010
Quantities	0	0	0	0	50	50
Other Procurement (Portable Security System):						
Funds	0	0	0	0	3,330	3,330
Quantities	0	0	0	0	140	140
Operation and Maintenance:						
Funds	0	0	0	0	28,920	28,920

(This funding reflects only that Missile Procurement, Other Procurement, and Operation and Maintenance associated with RDT&E programs.)

5. (U) RELATED ACTIVITIES: Advanced Strategic Missile Systems (ASMS), PE 63311F, is a program which develops ballistic missile technology for operational and future intercontinental ballistic missile (ICBM) applications. Specific components of the Minuteman III Penetration Aids program, entering full-scale development in FY 1987, were in advanced development in ASMS through FY 1986. ICBM Modernization, PE 64312F, is developing systems for the next generation missiles. Duplication of effort is avoided by assigning both of these programs and Minuteman development activities to a single organization, the Ballistic Missile Office. The Ballistic Missile Office coordinates activities with Air Force Logistics Command's Ogden Air Logistics Center, the organization with program management responsibility for Minuteman.

6. (U) WORK PERFORMED BY: The primary contractors are TRW, Redondo Beach, CA (Program Support-systems engineering/technical assistance); Tracor, Austin, TX (penetration aids chaff development); Acurex, Mountain View, CA (penetration aids passive decoy development); General Electric, Philadelphia, PA (flight test reentry vehicle integration); and Rockwell International, Anaheim, CA (accuracy incentives). The responsible Air Force agency is Air Force Systems Command's Ballistic Missile Office, Norton Air Force Base, CA.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 133B, Minuteman Squadrons

A. (U) Project Description: The project supports research and development activities required to keep Minuteman a viable strategic deterrent force. Specific programs supported include ICBM Integrated Electronics an[illegible]

Minuteman Portable Security System. Program Support includes the Minuteman Long Range Plan effort which incorporates the efforts of the Ballistic Missile Office, SAC and AFLC to identify those areas that will require upgrade, replacement or refurbishment in the future. As a continuing effort, Program Support also includes funding for systems engineering/technical assistance and all operating costs (collateral testing, analyses, travel, etc.) in support of Minuteman programs at the Ballistic Missile Office. Continuing technical expertise for planning, analysis, design, test, and associate systems engineering support is necessary to develop and prove prototypes of improvements to the operational system in accordance with approved program direction.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: This program resolved problems found during FY 1986 assembly and checkout of Command, Control, Communications Integration Phase II equipment. It conducted guidance studies for accuracy improvement, reentry vehicle studies to refine required penetration aids characteristics, and program planning for the Minuteman III Penetration Aids program which will take penetration aid components developed in the Advanced Strategic Missile Systems program and adapt/integrate them for use on Minuteman III. Program planning began for the Intercontinental Ballistic Missile (ICBM) Integrated Electronics program, which combines Launch Control Center (LCC) Integration, Computer Aided Message Processing and Minuteman Flexible Targeting programs into a single project.

(2) (U) FY 1987 Program: This program will resolve any problems encountered during the final assembly and checkout of Command, Control, Communications (C^3) Integration Phase II equipment. Development will begin of a portable security system that will reduce security police manpower requirements by decreasing the number of security guards required on Minuteman launch facilities that have malfunctioning security systems. System studies will begin for the ICBM Integrated Electronics program. This program will design new consoles for the LCC and begin development of new hardware and software that will allow automated processing of emergency action messages in the LCC and rapid retargeting of Minuteman II missiles to counter strategic relocatable targets. The new system will optimize crew capability to operate in Emergency War Order environments. The Minuteman Long Range Plan effort will publish a twenty-year technical plan in March, outlining efforts that must be conducted in the future to maintain the operational capability of Minuteman.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Engineering development of the hardware and software for the ICBM Integrated Electronics program will begin. The FY 1988 program provides initial hardware and software development for LCC integration, computer aided message processing and rapid retargeting of ICBMs. Development continues for the Portable Security System program. The category IV cost estimate, reviewed in April 1986, was arrived at through the use of program office assessments utilizing past acquisition history of similar efforts, Technical Analysis and Cost Estimate studies, and data obtained from program office support functions.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Development continues for the hardware and software for the ICBM Integrated Electronics program and the Portable Security System development ends in FY 1989. The Minuteman Long Range Plan will produce another twenty-year technical plan as the output of studies and testing of Minuteman subsystems. The category IV cost estimate, reviewed in April 1986, was also arrived at through the use of

program office assessments utilizing past acquisition history of similar efforts, Technical Analysis and Cost Estimate studies, and data obtained from program office support functions.

(5) (U) Program to Completion: Development of the Intercontinental Ballistic Missile (ICBM) Integrated Electronics program hardware and software will continue through 1991. Program Support and the Minuteman Long Range Plan effort are continuing programs.

C. (U) Major Milestones:

	Milestones		Dates
(1) (U)	ICBM Integrated Electronics Engineering Development Begins		October 1986
(2) (U)	Minuteman Twenty-Year Technology Plan published		March 1987
(3) (U)	Command, Control and Communications Integration Phase II Full Operational Capability (FOC)		October 1987
(4) (U)	Minuteman Twenty-Year Technology Plan published		March 1989
(5) (U)	Minuteman Portable Security System First Production		FY 1990
(6) (U)	ICBM Integrated Electronics Kit Installation Begins		FY 1991
(7) (U)	ICBM Integrated Electronics Installation Complete	*(FY 1994)	FY 1995

*Date presented in FY 1987 Descriptive Summary.

(U) Explanation of Milestone Change

(7) (U) ICBM Integrated Electronics Installation Completion slipped because of program funds restructure.

9. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3626, Minuteman III Penetration Aid Upgrade

A. (U) Project Description: This project develops a new penetration aid system that will enable Minuteman III to successfully attack targets protected by the upgraded Soviet antiballistic missile system. The new penetration aid system will consist of new, lightweight chaff for exoatmospheric concealment and decoys for endoatmospheric simulation. The program will also modify the Minuteman III deployment system and flight software. Development will include seven flight tests on Minuteman III boosters.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Not applicable.

(2) (U) FY 1987 Program: The Minuteman III Penetration Aids Upgrade Program will enter full-scale development. Early studies will focus on system tradeoffs and incorporation of Advanced Strategic Missile System program technologies, culminating in a System Design Review in July 1987. A Joint Resources Management Board Milestone II review is tentatively scheduled for February 1987.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The penetration aids development continues with two sounding rocket tests of the chaff system. Decoy and chaff design will continue leading to a Preliminary Design Review in August 1988. The contractor will begin design of decoy flight test articles for flights in FY 1989. The category I cost estimate is based on the October 1986 firm, fixed-price contract profile.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Development continues leading to final design of decoy, chaff and deployment system and Critical Design Review in December 1989. Two Intercontinental Ballistic Missile (ICBM) flight tests are scheduled in FY 1989 and the design will be tested in two underground nuclear tests. The category I cost estimate is based on the October 1986 firm, fixed-price contract profile.

(5) (U) Program to Completion: Minuteman Penetration Aids development ends in FY 1990. Final five verification and demonstration flight tests occur in FY 1990 and 1991.

C. (U) Major Milestones:

Milestones		Dates
(1) (U) Minuteman III Penetration Aids Full-Scale Development Begins	*(October 1986)	March 1987
(2) (U) System Design Review		July 1987
(3) (U) Preliminary Design Review		August 1988
(4) (U) Critical Design Review		December 1989
(5) (U) First Production		January 1990
(6) (U) Initial Operational Capability (IOC)	*(FY 1991)	FY 1992
(7) (U) Full Operational Capability (FOC)	*(FY 1992)	FY 1993

*Date presented in FY 1987 Descriptive Summary.

(U) Explanation of Milestone Changes

(1) (U) Full-Scale Development slipped to permit OSD Program Review before contract award.
(6) (U) IOC slipped because of delay in program start and restructure of program funds.
(7) (U) FOC slipped because of delay in program start and restructure of program funds.

10. (U) COOPERATIVE AGREEMENTS: Not applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 11312F — Title: Post Attack Command and Control System (PACCS)
DOD Mission Area: 331 - Strategic Command and Control — Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		5,583	9,015	943	1,203	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: To provide a survivable command and control facility for the Single Integrated Operation Plan Commanders in Chief (CINCs) that will support the National Command Authority during all phases of a general war. Supports activities currently underway involving all the aircraft of the Worldwide Airborne Command Post System (WWABNCP), including Commander-in-Chief Strategic Air Command; United States Commander-in-Chief European Command; United States Commander-in-Chief Atlantic Command; and United States Commander-in-Chief Pacific Command.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	3,993	14,798	28,045	N/A	Continuing	N/A

EXPLANATION: (U) RDT&E funding changes in FY 1987 reflect a Congressional cut and in FY 1988 reflect moving WWABNCP Replacement program money from PE 11312F to PE 64216F, WWABNCP System Replacement. Increase in RDT&E funding in FY 1986 reflects an add to the PE for a transfer of funds to DCA at OSD direction.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable

5. (U) RELATED ACTIVITIES: The following Program Elements support the WWABNCP: Strategic Air Command Communications, PE 11316F; Air Force Satellite Communications Program, PE 33601F; System Survivability, PE 64711F; Electromagnetic Radiation Test Facilities, PE 64747F; National Emergency Airborne Command Post, PE 32015F; Air Force Support to Minimum Essential Emergency Communications Network, PE 33131F; Milstar, PE 33603F; Peacekeeper, Minuteman Common Airborne Launch Control Center, PE 11215F; Nuclear Detonation Detection System, PE 12433F; and WWABNCP System Replacement, PE 64216F.

6. (U) WORK PERFORMED BY: The WWABNCP System Program Office has responsibility for the program. This is an Air Force Logistics Command organization located at Tinker AFB, OK.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 11312F, Post Attack Command and Control System

A. (U) Project Description: The Worldwide Airborne Command Post (WWABNCP) System Program Office conducts, on a continuing basis, an Electromagnetic Pulse (EMP) Engineering Surveillance program relative to the EC-135 aircraft. This effort establishes and analyzes EMP design specifications for new systems, supports limited subsystem and component testing, investigates new installation techniques to achieve improved EMP protection and provides a continuing analysis of the EMP survivability of the EC-135, a critical airborne Command and Control resource. This is a continuing level-of-effort program.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: The FY 1986 effort continued the EMP Engineering Surveillance program on modifications scheduled for installation on the EC-135. These included the Ultra High Frequency Line-of-Sight (UHF/LOS) communication system, Peacekeeper/Minuteman Common Airborne Launch Control System, Diversity Reception Equipment, and the Ground Wave Emergency Network. These efforts ensure the hardness maintenance and surveillance program is compatible with the EC-135 hardness maintenance plan. Additionally, a system level EMP test was conducted at Kirtland AFB. The Electronic Systems Division completed a system concept study for the WWABNCP Replacement.

(2) (U) FY 1987 Program: The FY 1987 effort will initiate the Concept Exploration phase for the development of a command, control, and communications suite for an advanced airborne command post. Additional studies will be conducted to determine candidate aircraft requirements and costs. These efforts are for WWABNCP System Replacement that will be accomplished under a new PE (64216F) for the FY 1988 and on efforts. The EMP surveillance will continue to ensure new systems installed on the airborne command posts during the next five years comply with established standards for nuclear hardness.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The FY 1988 effort will continue the EMP surveillance program for the EC-135 to insure the survival of these critical assets against nuclear effects. In FY 1988 planning will start for an aircraft and command and control (C^2) suite system EMP test at Kirtland Air Force Base in early FY 1989. This will be the first system test of the hardness levels achieved by the new Ultra High Frequency line-of-sight radio system installed under the PACER LINK Phase II modification. Additional engineering reviews and studies of hardness levels of projected C^2 improvements will continue. This program is increasingly important in light of the many significant command and control communications modifications scheduled to be installed on the WWABNCP fleet in FY 1988 through FY 1992. It is crucial that these new systems meet established EMP requirements to insure overall WWABNCP system survivability. Cost estimates are based on previous levels of effort for this program. Cost category is I, Comprehensive. Cost estimates were reviewed in March 1986.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The FY 1989 effort will be centered on performing a system EMP test of a PACER LINK modified EC-135 airborne command post, and the analysis of these test results. The the EMP surveillance program will continue for projected EC-135 C^2 modifications to insure these critical new systems are survivable against nuclear effects. This program will remain increasingly important in light of the

many significant command and control communications modifications scheduled to be installed on the WWABNCP fleet in FY 1989 through FY 1993. It is crucial that these new systems meet established EMP requirements to insure overall WWABNCP system survivability. Cost estimates are based on previous levels of effort for this program. Cost category is I, Comprehensive. Cost estimates were reviewed in March 1986.

(5) (U) Program to Completion: This is a continuing program. The Electromagnetic Pulse (EMP) Engineering Surveillance program is a continuing program, as survivability of the EC-135 fleet must be ensured. Specific tasks necessary to conduct this effort will be identified as they occur. The Worldwide Airborne Command Post (WWABNCP) Replacement program continues under PE 64216F.

C. (U) Major Milestones:

Milestones	Dates
(1) (U) Ultra-High Frequency/Line of Sight (UHF/LOS) Critical Design Review	July 1985
(2) (U) Initial aircraft installation of UHF/LOS system on EC-135	June 1986
(3) (U) Initial EC-135 System Level EMP Test Report	July 1986
(4) (U) WWABNCP Replacement Joint Requirements Management Board Milestone I	March 1987
(5) (U) EC-135 System Level EMP Test	FY 1989

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 12310F
DOD Mission Area: 391 - Strategic Information Systems

Title: NCMC - Tactical Warning/Attack Assessment (TW/AA) Systems
Budget: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		38,978	31,217	57,849	52,582	Continuing	N/A

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program funds the major portion for replacement systems for the Tactical Warning/Attack Assessment (TW/AA) command, control and communications architecture centralized within the North American Aerospace Defense Command (NORAD) Cheyenne Mountain Complex (NCMC). The requirement to rapidly replace current operational systems is documented in numerous Air Force, Department of Defense, and General Accounting Office reports.

Software is becoming increasingly difficult to modify in response to the threat changes, upgrades in sensor capability and changes in information displays. This replacement program is designed, in combination with other parallel efforts referenced in paragraph 5, to incrementally upgrade and replace the current operational systems and facilities in accordance with the Joint Chiefs of Staff approved Integrated Tactical Warning and Assessment Architecture. Once completed, this architecture will provide the commander-in-chief (CINC) United States Space Command, CINC-Strategic Air Command, the National Command Authority, other nuclear-CINCs, and command centers with automated computer based command, control, and communications systems capable of meeting the needs of the United States well into the next century.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	51,108	32,935	72,527	N/A	Continuing	N/A
Other Procurement	17,127	2,285	12,858	N/A	Continuing	N/A

EXPLANATION: (U) RDT&E and Other Procurement funds reflect a restructure of the Communications Systems Segment-Replacement program due to delays in Full Scale Development contract award and low prior year obligation rates.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

Other Procurement:						
Funds	8,117	2,285	8,240	19,269	Continuing	N/A
Quantities	Not Applicable					

PE: 12310F

448

Program Element: 12310F
DOD Mission Area: 391 - Strategic Information Systems

Title: NCMC - Tactical Warning/Attack Assessment (TW/AA) Systems
Budget Activity: 3 - Strategic Programs

5. RELATED ACTIVITIES: This program provides the major portion of replacement systems for the upgrade of the US and North American Aerospace Defense (NORAD) Command, Control, and Communications Architecture. PE 12436F, Command Center Processing Display System, provides a replacement system for the missile warning systems within the architecture. PE 12311F, NCMC Space Defense Systems, is providing an upgrade to the Space Defense Operations Center and NORAD Space Surveillance Center for control of US space assets and cataloguing/monitoring of all space objects. Sensor programs, also currently being upgraded, which form the major external elements to the Integrated Tactical Warning and Assessment Architecture include the Ballistic Missile Early Warning System (PE 12423F), Sea Launched Ballistic Missile Early Warning System (PAVE PAWS)(PE 12432F), and SPACETRACK (PE 12424F).

6. (U) WORK PERFORMED BY: This effort is managed by Air Force Systems Command's (AFSC) Electronic Systems Division (ESD), Hanscom AFB, MA. The Communications System Segment-Replacement (CSS-R) contractor is GTE Sylvania, Needham, MA. The Survivable Communications Integration System (SCIS) contractor is E Systems Incorporated, ECI Division, St. Petersburg, FL. Technical support is provided by MITRE Corp., Bedford, MA. Contractors for Granite Sentry and the Offutt Processing and Correlation Center (OPCC) have not been selected.

7. (U) PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 12310F, North American Aerospace Defense (NORAD) Cheyenne Mountain Complex (NCMC) - Tactical Warning/Attack Assessment (TW/AA) Systems

A. (U) Project Description: The North American Aerospace Defense (NORAD) Cheyenne Mountain Complex (NCMC) upgrade and replacement of Tactical Warning/Attack Assessment (TW/AA) systems will provide automated and modularized computer based systems in accordance with the overall Joint Chiefs of Staff approved Integrated Tactical Warning and Assessment Architecture. This program is divided into the following four major efforts: (1) The Communications System Segment-Replacement (CSS-R) subsystem will replace current computers and software to process all communications in and out of the NCMC: (2) The Survivable Communications Integration System (SCIS) will provide for the transmission of preattack and trans-attack survivable communications from sensors, receipt at and transmission from the NCMC and Offutt Processing and Correlation Center (OPCC), and receipt at other designated command centers (3) Granite Sentry will provide a replacement for the NORAD Command Post facility and modernization of supporting computers and software in the Air Defense Operations Center, the Resource Center, and the Weather Center. Further, in coordination with other related programs, Granite Sentry will develop common work stations and displays for all NCMC systems in the Integrated Tactical Warning and Assessment Architecture: (4) The OPCC, a new start in FY 1991 and based on Air Force Space Command approved Statement of Operational Need 03-85, will provide the second fusion center for processing integrated tactical warning and assessment data. These four programs will provide for both ballistic missile and atmospheric tactical warning to Commander-in-Chief (CINC)-NORAD, CINC-United States Space Command, CINC-Strategic Air Command, and National Command ...ies. Each subsystem will be acquired in incremental blocks to provide measurable improvements in the

operational capability of the command, control, and communications system over the entire acquisition period.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Block 1 of the Communications System Segment-Replacement (CSS-R) program, designated to perform the automated technical control functions for the tactical warning/attack assessment system, is completing the full-scale development phase. All hardware and software design was completed and unit testing of modular software was performed. Further, all software modules were integrated and hardware/software integration is over two-thirds complete. CSS-R successfully completed a scheduled progress demonstration in May 1986. The Survivable Communications Integration System (SCIS) program completed validation of technical specifications and awarded a full scale development/production contract in August 1986. After a detailed evaluation of requirements and acquiation concept evaluations, managing and using commands established a Granite Sentry acquisition approach which will initiate full scale development in FY 1987. Finally, the Air Force validated the requirements for the Offutt Processing and Correlation Center (OPCC) which will function as the second fusion center for the Joint Chiefs of Staff approved Integrated Tactical Warning and Assessment Architecture. No FY 1986 RDT&E funds were used for for the OPCC.

(2) (U) FY 1987 Program: Testing of the CSS-R Block 1 computer programs, circuit health, and status monitoring functions of the technical control system will continue. Block 1 will complete functional qualification testing and Air Force acceptance is scheduled for June 1987. The CSS-R Block 2 full-scale development/production was awarded in January 1987. Block 2 will eventually complete the CSS-R system by providing overall control of message distribution throughout the North American Aerospace Defense (NORAD) Cheyenne Mountain Complex (NCMC). CSS-R Block 2 will complete a Preliminary Design Review in FY 1987 documenting completion of system engineering and high level software design. SCIS full scale development will be in high gear by completing both Preliminary and Critical Design Reviews. Numerous components and software modules will be evaluated to validate system design and performance. Both initial and detailed software design will be completed by year end and modularized testing of software will be conducted in preparation for hardware/software integration tests. Granite Sentry will purchase commercial off-the-shelf computer systems to aid in the design and development of software functions. The Preliminary Design Review for software will be completed and the Request for Proposal for full scale development/production for a hardware and integration contractor will be released. The Granite Sentry Competitive Source Selection for full scale development will be in progress by year end. No RDT&E funds will be used for the OPCC in FY 1987. However, the OPCC facility design will be completed and a competitive request for proposal for facility construction will be released.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: CSS-R Block 2 will complete detailed design and modular unit testing of computers and software to distribute warning messages by completing the system Critical Design Review. Developmental testing will continue to complete hardware/software integration. The SCIS program will complete systems testing and hardware/software integration testing. Both contractor and Air Force in-plant development test and evaluation of SCIS will be completed. Initial SCIS installation in the

Test Development and Training Center will be completed. Granite Sentry will award a full scale development/production integration contract after a competitive source selection and will conduct a Critical Design Review on software. The Air Defense Operations Center developed under Granite Sentry will reach initial operational capability. Communications Systems Segment-Replacement (CSS-R) cost estimates are Category II, mature and based on final negotiated contractor costs. Survivable Communications Integration Systems (SCIS) cost estimates are Category I, based on the FY 1986 awarded contract. Granite Sentry and Offutt Processing and Correlation Center (OPCC) cost estimates are Category IV, based on internal program office and using command cost estimates.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The CSS-R Block 2 program will complete hardware/software integration and will complete a progress demonstration test. Contractor and Air Force in-plant development test and evaluation will be conducted. A Functional Qualification Test is also planned. Initial installation and checkout of the complete CSS-R will be finished in the Technical Development and Training Center. SCIS will undergo complete systems testing during FY 1989. This will include successful completion of development test and evaluation and both physical and functional configuration audits. Granite Sentry will reach initial operational capability at the North American Aerospace Defense (NORAD) Chyenne Mountain Complex (NCMC) Command Post. SCIS will be installed at the OPCC during FY 1989. Cost estimate categories for these programs are the same as described in paragraph (3) above.

(5) (U) Program to Completion: These are continuing programs. CSS-R will undergo development and operational test and evaluation during FY 1990 and FY 1991. CSS-R will reach initial operational capability (IOC) in FY 1991. SCIS will complete operational test and evaluation in FY 1990 and reach IOC. Granite Sentry will reach IOC for the Resource Center in FY 1990, transition all systems to the newly operational CSS-R during FY 1991, and will reach full operational capability in FY 1992. Operational capability of the OPCC will follow that of the NCMC in FY 1994.

C. (U) Major Milestones:

	Milestones		Dates
(1)	(U) CSS-R Concept Definition contract award		July 1983
(2)	(U) CSS-R Development Contract Award		June 1984
(3)	(U) CSS-R Block 1 Critical Design Review (CDR)		January 1985
(4)	(U) Granite Sentry Statement of Operational Need (SON) Validated		June 1985
(5)	(U) SCIS development contract award	*(3rd Qtr FY86)	August 1986
(6)	(U) OPCC SON validated		November 1986
(7)	(U) CSS-R Block 2 start	*(June FY86)	January 1987
(8)	(U) SCIS CDR		August 1987
(9)	(U) Granite Sentry development contract award		October 1987

(U) Milestones (cont)

(10)	(U)	Granite Sentry Software Critical Design Review (CDR)	December 1987
(11)	(U)	Communications System Segment-Replacement (CSS-R) Block 2 CDR	February 1988
(12)	(U)	Granite Sentry Air Defense Operations Center Initial Operational Capability (IOC)	December 1988
(13)	(U)	Granite Sentry Command Post IOC	FY 1989
(14)	(U)	Survivable Communications Integration System (SCIS) Limited Operational Capability	FY 1989
(15)	(U)	Granite Sentry Resource Center IOC	FY 1989
(16)	(U)	SCIS IOC	FY 1990
(17)	(U)	CSS-R IOC	FY 1991
(18)	(U)	CSS-R Full Operational Capability (FOC)	FY 1992
(19)	(U)	Granite Sentry FOC	FY 1992
(20)	(U)	SCIS FOC	FY 1992
(21)	(U)	Offutt Processing and Correlation Center FOC	FY 1994

* Date presented in FY 1987 Descriptive Summary

(U) Explanation of Milestone Changes

(5) (U) Actual contract award.
(7) (U) Contract award delayed due to extended negotiations.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 12311F Title: NCMC - Space Defense Systems
DOD Mission Area: 391 - Strategic Information Systems Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		52,654	39,125	26,371	24,004	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: A Space Defense Command and Control System (SPADCCS) is needed to satisfy Presidential and Secretary of Defense directives to improve, in a balanced manner, the space defense capability of the United States. Current space defense operations lack real-time response and cannot satisfy new operational requirements. This program element supports the development of 1) the Space Defense Operations Center (SPADOC) to effectively manage all US space defense and surveillance activities through the 1990s; 2) to upgrade and integrate the activities of the US Space Command Space Surveillance Center (SSC) for cataloguing of space objects, orbit parameter computation, and associated interfaces to communications networks; and 3) to integrate the SPADOC and SSC onto a common architecture.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	56,518	41,284	23,974	N/A	Continuing	N/A
Other Procurement	41,883	49,692	17,790	N/A	Continuing	N/A

EXPLANATION: (U) FY 1986 actuals were lower than expected due to a delay in contract award. A request for $15,000,000 FY 1987 Congressional reprograming authorization has been submitted and the FY 1987 estimate in paragraph 1 reflects approval. The FY 1988 RDT&E estimate is now based on negotiated contracts. The FY 1987 and FY 1988 Other Procurement budget previously included all NCMC programs. The current budget reflects only this Program Element.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
Other Procurement:						
Funds	41,020	10,438	4,248	9,118	Continuing	N/A
Quantities	Not Applicable					

5. (U) RELATED ACTIVITIES: PE 12424F, SPACETRACK, provides sensor data to SPADOC. SPADOC will provide survivability and warning information to the Consolidated Space Operations Center, PE 35130F.

6. (U) WORK PERFORMED BY: Air Force Systems Command's (AFSC) Space Division (SD), Los Angeles AFS, CA, is responsible for overall management of the Space Defense Command and Control System (SPADCCS) development. AFSC's Electronic Systems Division (ESD), Hanscom AFB, MA, is the acquisition/program management agency for the Space Defense Operations Center (SPADOC) effort. Ford Aerospace and Communications Corporation, Colorado Springs, CO, is the prime contractor: IBM, Gaithersburg, MD, is the major hardware subcontractor: and TRW, Colorado Springs, CO, is the major software subcontractor. System engineering contractors are Science Applications Incorporated, La Jolla, CA: Aerospace Corporation Los Angeles, CA; and MITRE Corporation, Burlington, MA.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 12311F, North American Aerospace Defense (NORAD) Cheyenne Mountain Complex (NCMC) - Space Defense Systems

A. (U) Project Description: Space Defense Operations Center (SPADOC) development will provide an integrated space defense and surveillance command and control capability. SPADOC will provide the necessary information to assess the status of operational US space assets as well as alerting, warning, and verification of hostile space events. In addition, SPADOC will provide an automated and highly accurate catalogue of all space objects and will be capable of meeting US defense requirements for the foreseeable future. Finally, SPADOC will provide the command control interface among space asset owners, operators, users, operational commanders, and the National Command Authority. SPADOC has evolved in phases from a totally manual system in 1979 to the current SPADOC III. The acquisition approach for SPADOC phase IV is in three separate yet overlapping development/procurement blocks. Each block is designed to provide the user with a measured phased improvement in capability. SPADOC IV Block A provides the basic SPADOC IV framework, facility renovation, hardware, executive level software, mathematical algorithms, and a measured increase in assessment and warning capability. SPADOC IV Block B will upgrade the US Space Command Space Surveillance Center (SSC) orbital generation capability for high interest satellites and increase the space object cataloguing capacity to satisfy the increased processing speed and data requirements imposed by the worldwide increased use of space. SPADOC IV Block C will complete the upgrade by assuming responsibility for all space object catalogue management and removing the space mission from the current 427M computers.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: A combined parametric bottoms-up cost estimate was completed for the SPADOC IV program in preparation for the Block B negotiations and contract award. SPADOC IV Block A completed systems integration testing, however, Block A did not reach Initial Operational Capability due to the need for software revisions. The SPADOC IV Block B development plan was completed on schedule and the Full-Scale Development/Procurement contract was awarded to initiate development of orbital generation and space cataloguing of computer programs.

(2) (U) FY 1987 Program: Due to reduced availability of FY 1987 RDT&E funds, the Space Defense Operations Center (SPADOC) IV Block B contract will undergo a major revision. SPADOC IV Block A will reach Initial Operational Capability. The Block B will complete Preliminary and Critical Design Reviews. Out year programs will be completely replanned.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: SPADOC IV Block B will undergo software and hardware integration and preliminary systems testing while Block C planning will be initiated. Detailed analyses of the operational performance of Block A will be conducted to influence the Block C design. Combined with initial operational test and evaluation data from Block A, a revised cost estimate will be completed. Cost estimates are Category I, on contract, for Block B and Category III, budgetary, for Block C. However, a mature estimate for Block C will be performed in FY 1988.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Block B systems integration testing will be completed leading to operational test and evaluation. Block C will enter Full-Scale Development/Procurement. Initial Operational Capability of Block B is now projected for early FY 1990. Cost estimates are the same as in paragraph (3) above.

(5) (U) Program to Completion: This is a continuing program. SPADOCs Full Operational Capability of early FY 1992 will be delayed due to funding. This program will continue to develop computer programs and install interfaces for the Space Defense Command and Control System and will continue until the system can provide timely warning of space attacks, develop countermeasures and responses, and control U.S. space weapon systems as needed.

C. (U) Major Milestones:

Milestones		Dates
(1) (U) Aerospace Defense Command Statement of Operational Need 3-79		December 1980
(2) (U) SPADOC IV Concept Definition Contract		December 1981
(3) (U) SPADOC IV A Contract Award		April 1983
(4) (U) SPADOC IV B Contract Award		June 1986
(5) (U) SPADOC IV A Initial Operational Capability (IOC)	*(April 1986)	June 1987
(6) (U) SPADOC IV C Contract Award	*(October 1988)	April 1989
(7) (U) SPADOC IV B IOC	*(February 1989)	March 1989
(8) (U) SPADOC IV C IOC and System Full Operational Capability	*(September 1991)	December 1991

*Date presented in FY 1987 RDT&E Descriptive Summary

(U) Explanation of Milestone Changes

(5) (U) Delay in software revisions required as a result of systems testing have delayed Initial Operational Capability.

(6), (7), and (8) (U) FY 1987 Appropriation reduction has necessitated program replan.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 12313F
DOD Mission Area: 332 - Strategic Surveillance and Warning

Title: Ballistic Missile Tactical Warning/Attack Assessment (TW/AA) System
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		1,965	2,874	2,265	2 536	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides system engineering and design analysis support for the nation's ballistic missile TW/AA system. This effort was initiated to implement the recommendations of the October 1980 report to the Committee on Armed Services, United States Senate, which addressed, "Recent False Alerts from the Nation's Missile Attack Warning System". The report recommended the Secretary of Defense consolidate management of essential TW/AA resources under a single commander and provide a centralized management structure for TW/AA acquisition programs. The objectives of this program are to promote fully coordinated management and technical interoperability in the acquisition of new or upgraded TW/AA systems and prevent duplication of effort between programs.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	2,100	3,084	2,878	N/A	Continuing	N/A

4. (U) OTHER APPROPRIATION FUNDS: Not applicable

5. (U) RELATED ACTIVITIES: The work in this program ensures the integration and coordination of development, acquisition and deployment efforts for missile warning sensor systems, communications systems and command centers. This program is related to all projects which support the Air Force tactical warning and attack assessment mission.

6. (U) WORK PERFORMED BY: Air Force Systems Command's Electronic Systems Division (ESD), Hanscom AFB, MA is responsible for overall management of this program. ESD coordinates program engineering efforts with the Space Command System Integration Office to ensure user requirements are met and no duplicative projects are undertaken. Program funds pay for technical engineering support, including support from the Mitre Corporation, a Federal Contract Research Center, headquartered in Bedford, MA.

Program Element: 12313F
DOD Mission Area: 332 - Strategic Surveillance and Warning

Title: Ballistic Missile Tactical Warning/Attack Assessment (TW/AA) System
Budget Activity: 3 - Strategic Programs

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 12313F, Ballistic Missile TW/AA System

A. (U) Project Description: This program provides the management framework through which the Air Force will apply coordinated oversight of the acquisition and interface of missile warning systems. New TW/AA-related systems defined in the project are later transferred to separate Program Elements for development, acquisition and deployment. Integration will be ensured through the development of technical standards and implementation of protocols for communications interfaces and by development of detailed plans for command center processing and display of missile warning information. Management of the TW/AA assets as an integrated system is necessary to ensure accurate, timely and unambiguous warning and assessment information to support force survivability actions and national decision making.

B. (U) Program Accomplishments And Future Efforts:

(1) (U) FY 1986 Accomplishments: Continued engineering and integration effort for classified sensor processing systems. Completed technical integrity study of TW/AA systems and evaluated impacts from the revised Attack Warning/Attack Assessment Architecture. Refined and implemented automated TW/AA Master Program Schedule. Demonstrated prototype interface management system with the Survivable Communications Integration System as the designated prototype program. Following demonstration, fully implemented the interface management system to provide engineering management and data clearinghouse service for all TW/AA acquisition efforts. Conducted preliminary system definition and scope of effort for the North American Aerospace Defense (NORAD) Command Processing and Display System, formerly the NORAD Standard Display System.

(2) (U) FY 1987 Program: Continue operation of master schedule and interface management systems to provide management and engineering assistance to all TW/AA-related acquisition efforts. Provide system engineering and integration support for TW/AA acquisitions transitioning to Initial Operational Capability including Ballistic Missile Early Warning System Upgrade, PAVE PAWS Site III and IV, Communications System Segment Replacement, and the Survivable Communications Integration System. Funding cited reflects the estimated level of effort for this project. No formal cost estimate is applicable.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Efforts will include cost effectiveness trade offs to determine appropriate methods of upgrading the tactical warning system to provide fully integrated attack warning capabilities to include all aspects of the projected air, space or missile threats to the United States.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: System engineering efforts in FY 1989 will evaluate the selected solutions to ensure on-going programs are meeting the defined requirements and to monitor the overall system baseline performance. Individual program baselines will be defined and maintained for all required developments.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not Applicable.

8. (U) PROJECTS OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 12325F
DOD Mission Area: 122 - Strategic Air Defense

Title: Joint Surveillance System (JSS)
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	1,372	3,267	2,156	1,754	Continuing	N/A
2976	Atmospheric Tactical Warning Connectivity	398	2,282	1,210	901	2,067	6,858
2996	FAA/AF Radar	974	985	946	853	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Joint Surveillance System (JSS) provides for air surveillance and command and control of air defense forces for airspace sovereignty. A joint-use network of Federal Aviation Administration (FAA) and military radars in the Continental United States (CONUS), Alaska, and Hawaii provide data to six Air Force Region Operations Control Centers (ROCCs) for air defense and to FAA Air Route Traffic Control Centers for air traffic control. Two JSS ROCCs were Canadian-acquired via Foreign Military Sales. US and Canadian JSS assets provide warning and threat assessment information to HQ North American Aerospace Defense Command (NORAD). The Atmospheric Tactical Warning Connectivity (ATWC) program will integrate Over-the-Horizon Backscatter (OTH-B) Radar Systems and the North Warning System (NWS) into the JSS ROCCs. OTH-B and NWS data must be provided to the ROCCs for improved airspace control and to allow selected target information to be forwarded to HQ NORAD for incorporation into raid recognition assessments. The FAA/AF Radar Replacement (FARR) Program will replace existing JSS search, beacon, and height-finding radars with solid-state, three-dimensional radars to improve mission performance and reduce operation and maintenance costs. The new radars will be incorporated into the FAA's National Airspace System, and the FAA will assume ownership and maintenance responsibility.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	2,017	3,509	2,279	1,883	Continuing	N/A
Other Procurement	3,567	31,568	48,687	N/A	Continuing	N/A

EXPLANATION: (U) Differences in FY 1986 RDT&E are a result of Gramm-Rudman reductions and adjustments made for FY 1986 actual obligations/expenditures. Differences in FY 1987 Other Procurement are a result of Congressional reduction of one FARR radar and an undistributed adjustment for Other Base Maintenance and Support. Differences in FY 1988 Other Procurement are a result of additions for Relocatable Over-the-Horizon Radar (ROTH-C) ROCC connectivity, Dispersal Communications, and Alaskan Air Command North Slope Radar which were offset by reduction of one additional FARR radar as well as undistributed adjustments for communications/electronics, spares, inflation, and contractor profit.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Other Procurement	3,430	12,142	37,549	33,155	133,635	360,784
968H (JSS) Funds	2,661[3]	100[4]	2,285[1]	4,667[2]	39,348	189,934
2976 (ATWC) Funds	0	9,051	4,045[5]	0	0	13,096
2996 (FARR) Funds	0	0[6]	26,422[7]	21,741	73,964	122,127
968H, 2976, 2996 Funds (spares)	769	2,991	4,797	6,747	20,323	35,627

Footnotes:
1. Joint Surveillance System (JSS) HAVE QUICK anti-jam communications enhancements.
2. $3,800 thousand for JSS HAVE QUICK anti-jam communications enhancements; $867 thousand for Region Operations Control Center (ROCC) software upgrades for Relocatable Over-the-Horizon Radar (ROTH-R) compatibility.
3. Two Region Operations Control Center/Airborne Warning and Control System (ROCC/AWACS) Digital Information Links (RADILs) and one ROCC System Support Facility (RSSF) workbench.
4. Two displays for the RSSF workbench.
5. Includes $443,000 for balance of printed circuit boards for ROCC Atmospheric Tactical Warning Connectivity (ATWC) modifications, $1,947 thousand for ROTH-R integration, and $1,655 for dispersal communications.
6. Reflects Congressional reduction of $16,194 due to contract award slip.
7. Includes $1,362 for Alaskan Air Command North Coast Radar.

5. (U) RELATED ACTIVITIES: Joint Surveillance System (JSS) Region Operations Control Centers (ROCCs) will receive surveillance data from Over-the-Horizon Backscatter (OTH-B) radars (PE 12417F) and the North Warning System (NWS) (PE 12412F). The JSS system includes Alaskan Air Command surveillance radars modernized by SEEK IGLOO (PE 12411F). JSS ROCCs interface with the E-3 Airbone Warning and Control System (PE 27417F). Project 2967, Atmospheric Tactical Warning Connectivity (ATWC) will provide for the eventual integration of data into the ROCCs from advanced sensor systems developed by the Air Defense Initiative (ADI) Surveillance Technology Program (PE 63738F). The joint-use JSS radar network is operated and maintained in accordance with Federal Aviation Administration (FAA)/Air Force National Agreement 614.

6. (U) WORK PERFORMED BY: Air Force program management for the JSS Region Operations Control Centers (ROCCs) is provided by Air Force Logistics Command, Wright-Patterson AFB, OH. The prime contractor for the JSS ROCCs is Hughes Aircraft Corporation, Fullerton, CA. Management for the Atmospheric Tactical Warning Connectivity project is provided by the Electronic Systems Division of Air Force Systems Command, Hanscom AFB, MA. The Federal Aviation Agency is the lead acquisition agency for the FAA/AF Radar Replacement Program in accordance with a 19 November 1984 sub-agreement to FAA/AF National Agreement (NAT) 711. The FAA and the Air Force have established a joint program office at HQ FAA, Washington, D.C., for this procurement.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 2976, Atmospheric Tactical Warning Connectivity (ATWC). The ATWC program will develop ROCC hardware/software modifications that allow Over-the-Horizon Backscatter (OTH-B) radar systems and the North Warning System (NWS) to be integrated into the JSS ROCCs. This effort will also provide for data exchange between Air Force OTH-B and Navy Relocatable Over-the-Horizon Radar (ROTH-R) systems. ATWC RDT&E also funds program office activities. This program will integrate OTH-B, Navy ROTH-R, and NWS radar data into the ROCCs. Hardware modification will expand the memory capability of the ROCC computers and display processors in order that radar tracks from the above systems may be displayed to the ROCC operators. The ROCC software is being modified to display the OTH-B and NWS track data and pass the information to the North American Aerospace Defense Command Cheyenne Mountain Complex. FY 1986 studies were also initiated on data processing and display requirements for integrating Navy ROTH-R data. Alternative architectures to meet these requirements were developed. In FY 1987, the alternative architectures for ROTH-R will be evaluated and one chosen for implementation. In FY 1987 and 1988, the initial ROCC integration hardware for OTH-B and NWS will be procured. In FY 1989, the selected integration hardware for the Navy ROTH-R will begin initial procurement.

B. (U) Project: 2996, FAA/AF Radar Replacement. The FAA/AF Radar Replacement (FARR) Program will replace existing JSS search, beacon, and height-finding radars with solid-state, three-dimensional radars to improve mission performance and reduce operation and maintenance costs. The new radars will be incorporated into the FAA's National Airspace System, and the FAA will assume ownership and maintenance responsibility resulting in an Air Force JSS cost avoidance of approximately $35 million a year. In FY 1986, a draft Request for Proposal (RFP) was issued which will lead to a final RFP in FY 1987 and contract award in early FY 1988. FY 1986-93 RDT&E funds provide technical engineering support for the FARR Joint Program Office.

8. (U) PROJECTS OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not applicable.

9. (U) COOPERATIVE AGREEMENTS: Not applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 12411F
DOD Mission Area: 332 - Strategic Surveillance and Warning

Title: Surveillance Radar Stations/Sites
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	12,345	20,118	5,224	1,671	Continuing	N/A
2980	North Atlantic Defense Sys (NADS)	4,490	6,636	4,346	832	Continuing	N/A
3137	POTEEN	4,146	12,599	0	0	0	16,745
3159	Caribbean Radar Sys	3,709	883	878	839	2,818	9,127
N/A	Drug Interdiction Aerostat Radars	0	0	0	0	0	0

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element funds strategic air defense improvements. The NADS funds improvements to command, control, and communication (C^3) and surveillance equipment in the North Atlantic required to correct air defense deficiencies in Iceland[

] Existing C^3 and surveillance equipment will be ineffective if challenged in wartime. The current Iceland Air Defense and Early Warning System is manually operated, antiquated and deficient in radar coverage. The lack of automation and inadequate C^3 facilities precludes timely distribution and exchange of vital air defense information received from radar sites, airborne early warning systems, maritime forces, and adjacent NATO air defense ground environment systems. [

] With existing deficiencies, Soviet aircraft with cruise missiles can exploit the poor C^3 capability and the gaps in radar coverage to attack critical targets in Iceland without warning[

] This area is considered a linchpin of the Northern flank and the key to reinforcement of the entire NATO theatre. The Caribbean Basin Radar Network project provides[

] The Air Force will also provide the US Army funds for[

]

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
RDT&E	19,700	25,004	15,527	N/A	183,773	251,173
Other Procurement	34,060	44,174	53,627	N/A	146,676	305,772

EXPLANATION: (U) RDT&E differences result from direction of the Office of the Secretary of Defense to reduce POTEEN to a FY 1987 project to examine alternate solutions to surveillance in the North Atlantic. Other Procurement differences result from FY 1987 Congressional funding for aerostat radars for the US Customs Service for drug interdiction, and a spares adjustment in FY 1986-89. All years reflect inflation adjustment.

4. OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
Other Procurement:	28,550	113,355	42,335	30,110	Continuing	N/A
2980 (North Atlantic Defense Sys)						
Funds	24,366	21,631	35,080	1,473	Continuing	N/A
Quantities	1[1]	4[2]	1[3]	0		
3159 (Caribbean Basin Radar Network)						
Funds	4,184	10,124	7,255	28,637	63,349	113,549
Quantities	1[1]	1[5]	1[5]	2[5/6]		
Drug Interdiction Aerostat Radars						
Funds	0	81,600	0	0	0	81,600
Quantities		5[4]				
Military Construction						
Funds	0	0	0	0	5,139	5,139

1. Iceland Region Operations Control Center (ICEROCC)

2. US Host Nation share of NATO Radar subsystem
3. US Host Nation share of NATO Iceland Air Defense System (IADS) Command, Control, and Communications (C^3) System
4. Aerostat-borne radars
5. Ground radars
6. Command Center upgrade

5. RELATED ACTIVITIES: The North Atlantic Defense System (NADS) is planned as a conjunctively funded NATO infrastructure project. The Interim Automated Air Defense System (IAADS) will use a Joint Surveillance System (PE12325F) Region Operations Control Center (ROCC). [

]

6. (U) WORK PERFORMED BY: Efforts are managed by the Electronic Systems Division, Hanscom AFB, MA. Technical support is provided by MITRE Corporation, Burlington, MA; Rome Air Development Center, Griffiss AFB, NY; and the Electromagnetic Compatibility Analysis Center, Annapolis, MD. The NADS Iceland Command and Control Enhancement (ICCE) contractor is Techdyne Systems Corp, Arlington, VA. No contractors have been selected for CBRN.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. Project: 2980, North Atlantic Defense System. The purpose of the NADS program is to correct serious air defense deficiencies in Iceland [ ] The NADS project consists of three subprojects: 1) the Iceland Command and Control Enhancement (ICCE) project; 2) the Interim Automated Air Defense System (IAADS) project; 3) the NATO NADS project. The ICCE project will develop, procure and deploy an E-3 digital data link for Iceland. The IAADS project will acquire, install, integrate and check-out a Joint Surveillance System (JSS) Region Operations Control Center (ROCC), deploy an additional two FPS-93 search radars in northern Iceland, fully automated radar transmission from all four FPS-93s, and provide necessary communications. The IAADS is an interim system and will be eventually replaced by the fully capable NATO-acquired NADS. The NATO NADS is planned as a conjunctively funded NATO infrastructure project for which the United States will serve as host nation. The NATO NADS project will acquire and deploy a new Command and Control Center (CCC), and four new three dimensional (3-D) radars on Iceland. It will also upgrade the entire communications system. The CCC will serve as the facility for conducting all air operations. ICCE and Interim Air Defense Control Facility equipment for the IAADS were procured in FY 1985. Two AN/FPS-93 radars from Alaska were refurbished by Air Force Logistics Command, the Type B cost estimate for the NATO program was completed, and site surveys were done. ICCE software development began, construction equipment and materials were prepositioned at northern sites, and northern site access roads were started. FY 1986 RDT&E continued ICCE software development and initiated software development and system engineering for IAADS. Joint Surveillance System (JSS) ROCC power, communication, and data transmission interfaces were prepared. Northern site construction began under NATO funding. FY 1987 RDT&E will complete ICCE and IAADS software development and system engineering and final integration and testing will begin. Efforts will begin to develop interfaces between NADS and North American Aerospace Defense Command (NORAD) systems. The NATO NADS radar contract will be awarded in FY 1987, and ... NATO NADS Command and Control Center contract will be awarded in FY 1988. FY 1989 continues the NATO NADS contract.

B. Project: 3159, Caribbean Basin Radar Network: The Caribbean Basin Radar Network project will provide

FY 1986 RDT&E provided for Caribbean Basin Radar Network (CBRN) system definition preparation activities, procurement documentation, site surveys and contracted technical support for Host Nation Agreements. FY 1987-91 RDT&E funds are for CBRN program office support.

8. (U) PROJECTS OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable

9. (U) COOPERATIVE AGREEMENTS: The North Atlantic Defense System (NADS) will be procured as a NATO Infrastructure project, funded primarily by the NATO Infrastructure fund. The United States is acting as Host Nation for this project on behalf of Iceland, another NATO member country. NATO procurement will include two separate contracts competed under international competitive bidding (ICB) procedures. The first procurement will be for the radar segment, which will procure four new state-of-the-art L-band radars to be installed in new facilities provided by NATO. The contract for the radar segment will be let in January 1987. The second procurement will complete the currently planned NATO project, and will include a new Command and Control Center (CCC), new on- and off-island communications, automated data processing (ADP) equipment, and total system integration, to include the new radars. Contract award is planned for January 1988. NATO has already approved infrastructure funds for the radar segment, and is currently screening the Type-B Cost Estimate for the CCC, Communications, ADP, and system integration effort. Funding shares are expected to be approximately 80% NATO and 20% Host Nation (US), based on recent procurement of similar air defense systems in the United Kingdom and other NATO countries.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 12412F
DOD Mission Area: 332 - Strategic Surveillance and Warning

Title: Distant Early Warning (DEW) Radar Stations
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		35,603	13,121	8,477	0	5,767	137,047
2710	North Warning	35,603	13,121	8,477	0	5,767	137,047

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This PE supports the operation of 31 existing DEW Line radar stations and funds the North Warning System (NWS) (DEW Line replacement program). The DEW Line provides tactical warning of bomber or cruise missile attack against the North American Continent through a radar line extending from Alaska to Greenland. The warning provides the National Command Authorities with time for decision making and survival actions, permits the launch of strategic retaliatory and command and control aircraft for survival, and alerts air defense fighters to intercept attacking aircraft. The DEW Line can be underflown by threat bombers because of numerous gaps at low altitude and marginal radar performance. Because of its age (1957 initial deployment), the DEW Line system is increasingly difficult and costly to operate and maintain. NWS program objectives are to eliminate low-altitude coverage gaps, improve radar performance, and reduce operation and maintenance costs. A combination of long-range, minimally attended radars and short-range, unattended gapfiller radars will be deployed. The NWS will be capable of detecting modern Soviet threat aircraft and cruise missiles NWS investment costs will be amortized by reducing operations and support costs attributable to NWS and phasing down the U.S. contribution to the operation of the CADIN-Pinetree radar system in Canada.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	39,871	14,430	6,744	N/A	2,869	138,451
Other Procurement	11,335	4,318	5,038	N/A	481,418	619,606

EXPLANATION: (U) The FY 1986 RDT&E reflects adjustment due to Gramm-Rudman-Hollings and revised inflation indices. FY 1988 increase reflects funds added to cover a Life-Cycle Cost Incentive clause in the short-range radar (SRR) full-scale development contract. Other Procurement changes in FY 1986 and FY 1987 result from spares adjustments, and the FY 1988 change results from direction by the Office of the Secretary of Defense.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Other Procurement:						
Funds	7,274	6,408	2,812	221,414	236,231	562,696
Quantities						
Satellite Stations	0	1	0	0	0	0
Central Maintenance Facility	0	0	0	3	0	0
Short Range Radar	0	0	0	17	20	37

5. (U) RELATED ACTIVITIES: The AN/FPS-117 minimally attended long-range radar developed under PE 12411F (Surveillance Radar Stations/Sites, Project SEEK IGLOO) will be used in the North Warning System (NWS). The study effort and procurement planning related to application of the AN/FPS-117 for DEW Line improvement was performed under PE 12411F. Radar coverage around North America will be contiguous with northern coverage provided by the NWS and eastern, western, and southern coverage provided by Over-the-Horizon Backscatter (OTH-B) radars in PE 12417F. Surveillance data from the North Warning System will be transmitted to northern Region Operations Control Centers developed under PE 12325F, Joint Surveillance System. The NWS program is a key element of air defense upgrades detailed in the Department of Defense North American Air Defense Master Plan and identified as part of the President's Strategic Modernization Plan. The current DEW Line is an integral part of North American Aerospace Defense Command surveillance and warning assets, and operation of the system is supported by a U.S.-Canadian Government-to-Government Agreement. Secretary of Defense Weinberger and Canadian Minister of Defense Nielson signed a Memorandum of Understanding on the Modernization of the North American Air Defense System on 18 March 1985. Canada will be responsible for all NWS communications equipment procurement and facilities construction in Canada. Negotiations are still in progress on aspects of NWS operations and support (O&S), which Canada will manage on behalf of both nations beginning 1 October 1989. The O&S costs for NWS will be shared on a 60-percent U.S./40-percent Canada basis.

6. (U) WORK PERFORMED BY: This effort is managed by the Electronic Systems Division, Hanscom AFB, MA. MITRE Corporation, Burlington, MA; Rome Air Development Center, Griffiss AFB, NY; Analytical Systems Engineering Corporation, Burlington, MA; Earth Technology Corporation, Seattle, WA; and the Electromagnetic Compatibility Analysis Center, Annapolis, MD are providing technical support. AN/FPS-117 long-range radars were procured from General Electric Company, Syracuse NY, in FY 1984 and FY 1985, and provided as Government Furnished Equipment to the system contractor. Sperry Corporation Great Neck, NY, was selected as the system contractor who will be responsible for the full scale development of the short-range radar (SRR) gapfiller radar station, overall system engineering, and development of a communications architecture for the Alaskan part of the North Warning System (NWS). Canadian NWS efforts are be managed by a Canadian program office located in Ottawa.

Program Element: 12412F
DOD Mission Area: 332 - Strategic Surveillance and Warning

Title: Distant Early Warning (DEW) Radar Stations
Budget Activity: 3 - Strategic Programs

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2710, North Warning System (NWS)

A. Project Description: The NWS will improve the operational capability of the existing DEW Line by eliminating low altitude coverage gaps, improving radar performance, and reducing operation and maintenence costs by approximately half. Present Soviet bombers can fly undetected through gaps in the DEW Line. The NWS will be capable of detecting improved threat bombers, such as BLACKJACK, and cruise missiles[ ] A NWS pre-planned product improvement will provide additional capability,[ ] Thirteen (13) AN/FPS-117 long-range radars were procured. An unattended short-range radar (SRR) gapfiller station will be developed and tested, and approximately 39 deployed. Communications upgrades to support the new NWS radar network and facilities construction are also part of the program.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: In FY 1986, station Critical Design Reviews (CDR) and the SRR Final Design Review were conducted and an SRR station Physical Configuration Audit (PCA) began. Prototype SRR station facility fabrication began, including tower erection, walkway installation and electrical/mechanical work for SRRs. Fabrication of two prototype SRRs continued and fabrication of a third began. SRR station software was coded, compiled, and debugged; software testing was completed, and in-plant component and subassembly testing was completed. Hardware/software integration began. Communications equipment was procured for long-range radar sites, and facilities refurbishment/modification began at the ten existing DEW sites that will receive AN/FPS-117s. Environmental studies continued.

(2) (U) FY 1987 Program: In FY 1987, the initial SRR PCA will be completed. Fabrication of the first two SRR prototypes will be completed, and the SRR Final Configuration Audit will be conducted. Hardware/software integration will be completed. Prototype facility construction will be completed, and the Alaskan prototype SRR will be installed. Arctic tests, reliability and maintainability tests will begin. Six AN/FPS-117 radars will be installed at existing DEW Line sites. A satellite ground terminal will be procured for the Alaskan Region Operations Control Center to allow data to be received from radar sites in Canada which provide coverage of portions of Alaska.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: In FY 1988, the third SRR prototype will be delivered to the Canadian test site and integrated with the Canadian communications equipment. Development Test & Evaluation (DT&E) will be completed by March 1988, reliability and maintainability demonstrations will be completed, and SRR station Initial Operational Test & Evaluation (IOT&E) will be completed in May 1988. A production decision will be made, leading to procurement of SRRs beginning in 1989. The remaining long-range radars will be installed; four at refurbished DEW Line sites and three at newly constructed sites on the east coast of Labrador. Initial Operational Capability will be achieved in August 1988.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: No RDT&E funds are requested. The increment of SRRs and SRR station equipment will be procured for installation beginning in FY 1991.

(5) (U) Program to Completion: The second increment of short-range radars (SRR) and SRR station equipment will be procured in FY 1990. Installation of SRRs will take place in FY 1991-92, and the three prototype SRRs will be retrofitted to production configuration. The North Warning System will achieve Full Operational Capability by the end of FY 1992.

C. (U) Major Milestones:

		Milestones	Dates
(1)	(U)	Full Scale Development (FSD) Request for Proposal (RFP) Released	May 1983
(2)	(U)	FSD Proposals Received	July 1983
(3)	(U)	Revised RFP Released	January 1984
(4)	(U)	Revised Proposals Received	February 1984
(5)	(U)	FSD Contract Award	August 1984
(6)	(U)	Production Contract Award for AN/FPS-117 Radars	February 1985/August 1985
(7)	(U)	Conclude Negotiations with Canada on NWS Acquisition	March 1985
(8)	(U)	SRR DT&E Completed	March 1988
(9)	(U)	SRR IOT&E Completed	May 1988
(10)	(U)	SRR Production Decision	June 1988
(11)	(U)	Initial Operational Capability	August 1988
(12)	(U)	SRR Production Contract Award	October 1988/October 1989
(13)	(U)	Full Operational Capability	4Q/FY 1992

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable

9. (U) COOPERATIVE AGREEMENTS: The North Warning System (NWS) is being developed and procured under the Memorandum of Understanding (MOU) on the Modernization of the North American Air Defense System signed 18 March 1985 by the United States and Canada. Under the terms of the MOU, the United States and Canada will share the cost and responsibility for acquisition and operation of NWS; the US cost share is 60%, the Canadian share is 40% of the acquisition cost. Operation and support of the NWS will be managed by Canada beginning in FY 1989, with associated costs being shared by the two nations using the same 60%/40% cost sharing arrangement. The cost sharing is based primarily on allocation of acquisition responsibility for the elements of the system. The United States is responsible for procuring the long-range radars, developing and procuring the short range radars, and all facilities in Alaska. Canada is responsible for acquisition of all long-haul communications and all new facilities in Canada, to include all short-range radar sites and three new long-range radar sites in Canada. Operations and support costs will similarly be shared by allocation of function between the two nations. The United States procured long-range radars in FY 1985, and awarded the short-range radar full-scale development contract to Sperry Corporation in FY 1984. Procurement of short-range radars begins in FY 1989. Canada contracted for long-haul satellite communications with CANAC-Microtel Ltd in 1986, and will begin site preparation in Canada in 1987.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 12417F — Title: Over-the-Horizon Backscatter (OTH-B) Radar
DOD Mission Area: 332 - Strategic Surveillance & Warning — Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		59,358	31,696	38,396	19,218	90,646	479,402

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program develops an Over-the-Horizon Backscatter (OTH-B) radar to satisfy requirements for tactical early warning of an attack on North America by bombers and air-to-surface missiles. Development of the OTH-B radar provides long-range wide area surveillance at all altitudes. It will detect and track airborne vehicles at ranges between approximately 500 and 1800 nautical miles from the radar. OTH-B increases warning time for survival of retaliatory forces and provides decision time for the National Command Authority consistent with ballistic missile warning requirements. It also significantly enhances redeployment options of available defense forces. The OTH-B will provide surveillance coverage of the east, west, and southern approaches to North America. Surveillance coverage in the north between the East and West Coast Systems will be provided by the North Warning System (PE 12412F).

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	65,738	33,877	46,525	N/A	65,878	463,688
Other Procurement	189,777	200,051	280,726	N/A	986,203	1,885,657

EXPLANATION: (U) Congress appropriated procurement funds for only one sector in FY 1987 vice two requested. The stretchout of the program has resulted in increased costs for program office support and sector acquisition. The later availability of sectors for testing results of pre-planned product improvements impacts RDT&E costs.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
Other Procurement: Funds	175,660	112,882	133,504	317,674	609,281	1,774,825
Quantitites (60 Degree Sectors)	1	1	1	2	4	11
Military Construction: Funds	8,558	14,300	23,300	68,720	114,374	239,352

5. (U) RELATED ACTIVITIES: The Over-the-Horizon Backscatter (OTH-B) radar system is being developed to provide all-altitude tactical early warning in support of our strategic air defense mission. The OTH-B will be compatible with related programs such as the North Warning System Radars (PE 12412F), the Joint Surveillance System (PE 12325F), and air defense interceptor forces. The OTH-B system will send track information to the Region and Sector Operations Control Centers of the Joint Surveillance System and to the North American Aerospace Defense Command (NORAD) Cheyenne Mountain Complex. Communications will be provided under OTH Radar Systems Communications (PE 12444F). Related OTH radar developments by the Office of Naval Research and the Navy Space & Naval Warfare Systems Command are monitored by the Air Force.

6. (U) WORK PERFORMED BY: The development of the OTH-B radar system and supporting OTH technical efforts are managed by the Air Force Systems Command's Electronic Systems Division, Hanscom AFB, MA. The radar prime contractor is the General Electric Co., Syracuse, NY. Major subcontractors include General Telephone and Electronics Corp, Waltham, MA; General Electric Co., Huntsville, AL: Continental Electronics, Dallas, TX; and TRW, Redondo Beach, CA. Continuing OTH technical efforts, analysis, engineering studies and support are provided by: Rome Air Development Center, Griffiss AFB, NY; SRI International Remote Measurement Laboratory, Menlo Park, CA; Naval Research Laboratory, Washington, D.C.; MITRE Corporation, Bedford MA; and the Air Force Geophysics Laboratory, Hanscom AFB, MA.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 12417F, Over-the-Horizon Backscatter (OTH-B) Radar

A. (U) Project Description: This RDT&E portion of the project converts the Experimental Radar System (developed by PE 63703F CONUS Over-the-Horizon Radar) into the initial 60 degree azimuthal coverage sector of the East Coast Radar System, integrates the first two production sectors to this sector to form the complete system, and tests the fully integrated system. Procurement and military construction funds budgeted for the project will allow acquisition of a 180 degree azimuthal coverage system on each coast of North America, a 240 degree coverage system in the Central United States for southern area surveillance and coverage of the ocean areas as a complement to the East and West Coast Systems, and a 120 degree coverage system in Alaska for Aleutian Island air defense. A Pre-Planned Product Improvement (P^3I) Program will be conducted.

B. (U) Program Accomplishments and Future Efforts:

(1) FY 1986 Accomplishments: Upgrade of the experimental radar system to a fully operational configuration, begun in FY 1982, was completed. This initial 60 degree sector began operating in January. This sector has successfully demonstrated the ability to detect and track single aircraft at ranges out to 1850 nmi. Automatic track correlation with enroute traffic reports from the Federal Aviation Administration and the international oceanic controls areas has been successfully tested. Sector reliability goals have been demonstrated. The second sector (first production sector) has passed transmit subsystem and interference tests. Tests with various existing OTH radars

lead to the conclusion that the OTH-B (in the planned West Coast Radar System configuration) will detect and track in the worst year of the eleven year sun spot cycle and at all hours in the seven best years of the cycle. (The East and West Coast Radar Systems differ only in the length of the receive antenna array. The East Coast Radar System will be modified to this configuration). The Environmental Impact Analysis Process for the Alaskan and Central Radar Systems was begun. A procurement contract for the West Coast Radar System was negotiated.

(2) (U) FY 1987 Program: The RDT&E funda will be used to integrate the initial sector to the first two production sectors to form the East Coast Radar System and perform Development Test and Evaluation (DT&E) on the integrated system. Support for Tactical Air Command (TAC), Strategic Air Command (SAC), Military Airlift Command (MAC), and Air Force Systems Command (AFSC) aircraft used as targets for the OTH-B radar DT&E will also be funded. Tests with the East Coast Radar System to verify the conclusions reached in FY 1986 on the capability to detect and track cruise missiles will be conducted. These tests will include use of AQM-34M drones modified to have the exact radar cross section of a cruise missile. The final Environmental Impact Statement for candidate Alaskan and Central Radar System sites will be prepared. Procurement of the West Coast Radar System will continue.

(3) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Initial Operational Test and Evaluation (IOT&E) will be performed on the integrated East Coast Radar System A Pre-Planned Product Improvement (P^3I) program to assure radar detection of future cruise missiles and explore techniques to reduce the required manpower levels at OTH sites will begin. Techniques to be explored include automated display processing, transmission beam steering, increasing transmit antenna effective radiated power and longer integration periods. The OTH-B antenna design will be modified for the Alaskan System to reduce Auroral effects through backlobe interference. Cost estimates are mature, category II. The Independent Cost Analysis (ICA) was completed in August 1983.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: P^3I efforts begun in FY 1988 will be continued in FY 1989. Promising developments will be implemented on one sector of the West Coast Radar System and tested to support decisions to incorporate the modification in all OTH-B sectors. A procurement contract for the Alaskan and Central Radar Systems will be completed and awarded. This contract will procure the first Alaskan sector and will contain priced options for the remaining Alaskan and Central sectors. These systems will incorporate successful developments from the P^3I program for better cruise missile detection capability. The receive antenna of sector 2 of the East Coast Radar System will be lengthened to the West Coast Radar System configuration for better cruise missile detection capability. Cost estimates are mature, category II. The ICA was completed in August 1983.

(5) (U) Program to Completion: The P^3I program will continue through FY 1995. This program will develop techniques to enhance OTH radar detection of advanced cruise missiles and other low cross section targets. The P^3I Program will also address automation improvements to reduce system operation and maintenance costs. Procurement of the Central and Alaskan Radar Systems will continue through FY 1991. The receive antennas of sectors 1 and 3 of the East Coast Radar System will be lengthened to the West Coast Radar System configuration.

C. **Major Milestones:**

Milestones	Dates
(1) (U) System Definition Complete	November 1973
(2) (U) Prototype Contract Award	March 1975
(3) (U) Initiate Program Restructuring	December 1976
(4) (U) Conclude Technical Feasibility Test	February 1981
(5) (U) Conclude Partial Initial Operational Test and Evaluation	June 1981
(6) (U) Air Force System Acquisition Review Council (AFSARC) Review	November 1981
(7) (U) Development Decision	January 1982
(8) (U) Development Contract Award	June 1982
(9) ( ) Initial Operational Capability (IOC) - East and West	
(10) ( ) IOC Alaskan Radar System	
(11) ( ) Final Operational Capability (FOC) Central Radar System	

*Date presented in FY 1987 Descriptive Summary.

(U) **Explanation of Milestone Changes**

(9) (U) West Coast Radar System IOC date slipped due to Congress funding only one sector in FY 1987 vice the two requested. This delays acquisition of the sector to FY 1988, delaying its availability by one year.

(11) Central Radar System FOC date advanced one year to [ ] due to increased procurement rates in FY 1989 to FY 1991 vice those contained in the FY 1987 Descriptive Summary.

9. (U) COOPERATIVE AGREEMENTS: The United States has a project agreement with Australia for the exchange of OTH-B research data. The agreement began in 1980. The Australian's have an experimental OTH-B radar that they are converting into an operational radar for the Royal Australian Air Force. They plan to procure three additional systems. A cooperative OTH radar program is being conducted with the UK under program element 12411F, Surveillance Radar Stations and Sites. The Navy is approaching several nations over cooperative arrangements for location of the Navy's OTH radar system. Under the terms of the Memorandum of Understanding on the Modernization of North American Air Defense System, signed in 1985, Canada will provide some manpower for operation of the East Coast, West Coast, and Central OTH-B Radar Systems.

Budget Activity: 3, Strategic Programs
Program Element: 12417F, Over-the-Horizon Backscatter (OTH-B) Radar

Test and Evaluation Data

1. (U) Development Test and Evaluation (DT&E): The OTH-B Radar System is currently in full scale development. The initial sector has operated since January 1986. The second and third sectors of the East Coast Radar System (ECRS) will begin operating in mid-1987. AF DT&E will be performed using the complete ECRS beginning in July 1987.

(U) The initial sector is an upgrade to the earlier Experimental Radar System (ERS) which had a complete DT&E and Initial Operational Test and Evaluation (IOT&E) conducted by Air Force Systems Command (AFSC) and Air Force Operational Test and Evaluation Center (AFOTEC) personnel. These activities proved that the key system characteristics (listed in paragraph 3 below) could be satisfied by an operational system.

(U) The OTH-B program manager is Col J. A. Lee, Electronic Systems Division (ESD), Hanscom AFB, MA. The development program prime contractor is General Electric (GE) Electronic Systems Division, Syracuse, New York. ESD is responsible for all DT&E. They will use the services of the following organizations to accomplish DT&E: MITRE Corp, GE, Stanford Research Institute International, Rome Air Development Center, AF Geophysics Laboratory, Naval Research Laboratory and the Federal Aviation Administration. The software will be independently verified and validated by Scientific Systems Inc and Calspan Corp. The Tactical Air Command (TAC), Strategic Air Command, Military Airlift Command (MAC), and AFSC will supply aircraft for the operational tests and TAC will supply the radar operators. GE will maintain the East Coast Radar System (ECRS) during DT&E.

2. (U) Operational Test and Evaluation (OT&E): The AFOTEC conducted a limited IOT&E from 1 March through 4 June 1981 on the ERS. The IOT&E was conducted primarily at the ERS combined receiver and operations site near Columbia Falls, Maine. Some testing was conducted at the transmitter site near Moscow, Maine.

(U) The results of the limited IOT&E on the ERS are documented in the OTH-B ERS IOT&E Final Report, July 1981 (Secret). This report details the operational deficiencies noted during testing. The report recommended the operational concept for the OTH-B radar be changed from single aircraft detection to raid detection probability.

(U) AFOTEC will conduct IOT&E (separate from DT&E) on the operational ECRS from 1 December 1987 through 31 March 1988. The ECRS consists of the initial sector plus the first two production sectors, providing integrated 180 degree azimuthal coverage of the eastern approaches to North America. The purpose of this IOT&E will be to evaluate the operational effectiveness and suitability of the OTH-B. Testing will include evaluation of radar performance, external interfaces, utility of data forwarded to air defense centers, and system reliability/maintainability. AFOTEC has activated OL-PK in Bangor, ME., as the operating location where the IOT&E test team will be located. The test team will have participating members from Tactical Air Command (TAC), Military Airlift Command (MAC), Air Force Space

Command (AFSPACECOM), Air Force Communications Command (AFCC), Air Training Command (ATC), Air Force Logistics Command (AFLC), and AFOTEC.

(U) The operational issues to be examined during the IOT&E are:

a. (U) Raid recognition. The OTH-B must provide sufficient information to North American Aerospace Defense Command (NORAD) for their use with other data to recognize a raid on North America.

b. (U) Effective barrier. The East Coast Radar System (ECRS) erects an electromagnetic barrier at all atmospheric altitudes that is used to detect and track aircraft. This barrier must have sufficient depth and contiguity to support tactical early warning.

c. (U) Northern barrier linkage. The ECRS barrier must overlap the coverage provided by North Warning System.

d. (U) Interoperability. Information from the ECRS will be provided to the Region Operations Control Centers and the NORAD Cheyenne Mountain Complex (NCMC). The Oceanic Control Areas will provide air movement data to the ECRS. Because of these interfaces, the interoperability between the ECRS and these facilities is a vital operational issue.

e. (U) Maintainability. The ECRS must be maintainable in accordance with the Tactical Air Command maintenance concept.

f. (U) Human factors. The design of the equipment, operations center, and consoles must be optimized for human performance.

g. (U) Operations training. The ECRS must be designed and constructed to allow individual and unit operations training as well as participation in NORAD exercises.

h. (U) Logistics supportability. The ECRS must be supportable by the existing organic structure.

i. (U) Availability. The ECRS must meet the required operational availability.

3. (U) Systems Characteristics:

Characteristic	Objective; Threshold	Demonstrated (Experimental Radar System)*
OPERATIONAL		
1. RAID DETECTION** PROBABILITY/% OF TIME	[-]	[ ]based on a theoretical extrapolation of values demonstrated for single aircraft.

Budget Activity: 3, Strategic Programs
Program Element: 12417F, Over-the-Horizon Radar System

Characteristic			Objective; Threshold	Demonstrated (Experimental Radar System)
2.		AVAILABILITY	[ ]	--
3.	(U)	MEAN TIME BETWEEN FAILURES (HRS)	40; 20	--

* This data was derived from one year of tests, under various seasonal/diurnal conditions, and at all ranges. Seasonal average data are based on Development Test and Evaluation (DT&E) results, other averages are based on Initial Operational Test and Evaluation (IOT&E) results.
** A raid consists of twenty or more aircraft or air-breathing missiles.

TECHNICAL

1.	(U)	DETECTION/TRACKING RANGE (NM) CAPABILITY	500-1800; 600-1500	500-1800
2.		ABSOLUTE ACCURACY (RMS) (NM)	[ ]	[ ]
3.		SPEED RESOLUTION (KTS)	[ ]	[ ]

Budget Activity: 3 Strategic Programs
Program Element: 12417F, Over-the-Horizon Radar System

4. (U) Current Test and Evaluation (T&E):

T&E Activity (Past 12 Months)

Event	Planned Activity	Actual Date	Remarks
Detection & Tracking	Oct 1986	Nov 1986	This activity combined with correlation & Identification test.
Correlation & Identification	Nov 1986	Nov 1986	Initial sector contractor DT&E Test Completion. A full capability demonstration.

T&E Activity (Next 12 Months)

Event	Planned Date	Remarks
Updated TEMP Approved	Jan 1987	
Detection & Tracking	Apr 1987	Multiple sector test
Correlation & Identification	May 1987	Multiple sector test
Start AF DT&E	Nov 1987	Follows Contractor Testing of Complete ECRS

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 12423F   Title: Ballistic Missile Early Warning System (BMEWS)
DOD Mission Area: 332 - Strategic Surveillance and Warning   Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		8,707	15,385	19,247	27,007	Continuing	N/A

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The mission of BMEWS is to detect and provide warning of a ballistic missile attack on the United States, Canada, the United Kingdom and Europe. There are three sites located at Thule, Greenland; Clear, Alaska: and Fylingdales, England. The BMEWS was built in the late 1950s and early 1960s. At the time, the Soviet threat consisted of a relatively small number of single warhead missiles, and our national nuclear strategy was one of massive retaliation. The system was originally designed to predict missile impact points by tracking the large, easy to detect, rocket booster and extrapolating the ballistic path of the single warhead. As the system has aged, portions of it have become increasingly difficult to support.[

] As a result, the system is being modernized with radar upgrades, to include new computer resources, at the Thule and Fylingdales sites. This will ensure reliable performance and better support the national nuclear retaliatory strategy of flexible response.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	12,636	16,225	22,746	N/A	Continuing	N/A
Other Procurement*	80,498	52,636	8,435	N/A	Continuing	N/A

*Includes spares

(U) The differences in funding levels reflect Gramm Rudman Hollings sequestration, and higher priority needs.

Program Element: 12423F — Title: Ballistic Missile Early Warning System (BMEWS)
DOD Mission Area: 332 - Strategic Surveillance and Warning — Budget Activity: 3 - Strategic Programs

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Other Procurement:						
Funds	72,031	49,535	4,449	2,656	Continuing	N/A
Quantities	Not Applicable					

5. RELATED ACTIVITIES: BMEWS is part of the national system for Tactical Warning and Attack Assessment. It confirms initial launch detection information provided by the [ ] and complements the information provided by the Sea Launched Ballistic Missile Detection and Warning network (PE 12432F) and the North American Aerospace Defense Command (NORAD) Space Detection and Tracking System (PE 12424F).

6. (U) WORK PERFORMED BY: The prime contractor for the Thule radar upgrade is Raytheon Corporation, Wayland, MA, with Control Data Corporation, Minneapolis, MN (computers), and TRW, Redondo Beach, CA (software) as subcontractors. The program is managed by Air Force Systems Command's Electronic Systems Division, Hanscom AFB, MA, in conjunction with the NORAD, Space Command, and Air Force Communications Command. General system engineering is provided by the Mitre Corporation, Bedford, MA.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 12423F, BMEWS

A. Project Description: The BMEWS modernization program will assure continued reliable operation of our Intercontinental Ballistic Missile warning network by upgrading the radars and data processing equipment at the Thule and Fylingdales sites. These improvements will solve system support problems associated with obsolescing equipment and increase the system's capability to detect, track and provide accurate and timely warning of the [ ]

At the Thule site the conventional detection and tracking radars are being replaced with a new dual-faced phased array radar. The Fylingdales modernization will replace the site's three existing tracking radars with a three-faced phased array radar. In each case, data processing capability is being expanded and new software is being implemented to allow the radars to report on a much larger number of smaller, more closely spaced objects. The [ ] problem will be solved and the system missile count capability will be significantly improved. This will greatly increase the system's tactical warning capability and also provide more accurate attack assessment information.

Program Element: 12423F | Title: Ballistic Missile Early Warning System (BMEWS)
DOD Mission Area: 332 - Strategic Surveillance and Warning | Budget Activity: 3 - Strategic Programs

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Installation and checkout work was completed on the Thule radar upgrade and on-site testing began in preparation for Initial Operational Capability (IOC) in mid-FY 1987. A solicitation was released to industry in June 1986 for the Fylingdales upgrade and contract award will occur in early FY 1987. The contract will be for three radar faces and 360 degrees of azimuth coverage. Test planning and overall system engineering continued.

(2) (U) FY 1987 Program: Upgrade of the Thule site will be completed and IOC achieved in mid-FY 1987. The Fylingdales upgrade effort will begin with software development, system engineering and equipment fabrication. Major design reviews will be conducted and in-plant testing for hardware and software will begin at the component level. Structural design efforts will be completed, and UK-funded facility construction will be started by a UK firm under subcontract to the US prime contractor. The new software will ensure maximum exploitation of the much greater target handling capacity of the new phased array radars.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Software development activities will continue for the Fylingdales system, and in-plant testing will be conducted on the software and on hardware at the subsystem/system levels. Although proven technology is being used for the modernization, siting considerations and potential ballistic missile trajectories uniquely associated with Fylingdales dictate a significant workload for system engineering, software development and test. Facility construction will continue through FY 1988 in concert with the installation of radar hardware integral to the facility structure (e.g., radar array plate assemblies). The Category II mature estimate for the Fylingdales upgrade is based on program office experience gained in the closely-related Thule upgrade and the four-site PAVE PAWS Expansion Program. This estimate was validated by a product division sufficiency review in March 1986.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Software development reviews and in-plant development testing at the system level will be completed in FY 1989 for the Fylingdales upgrade. Construction, acceptance testing and discrepancy resolution for the facility will be completed. Computer and radar equipment installation and checkout will be completed and on-site integration and testing will begin in FY 1989. The Category II mature estimate for the Fylingdales upgrade is based on program office experience gained in the closely-related Thule upgrade and the four-site PAVE PAWS Expansion Program. This estimate was validated by a product division sufficiency review in March 1986.

(5) (U) Program to Completion: The Fylingdales site will attain IOC in FY 1990. The BMEWS modernization is a continuing program; additional upgrade efforts will be implemented as necessary to accommodate Tactical Warning/Attack Assessment requirements.

C. (U) Major Milestones:

	Milestones		Dates
(1)	(U) Thule Radar Design Phase Contract Award		April 1982
(2)	(U) Thule Radar Design Phase Complete		November 1982
(3)	(U) Thule Radar Upgrade Contract Award		July 1983
(4)	(U) Fylingdales Radar Upgrade Contract Award	*(August 1986)	January 1987
(5)	(U) Thule Radar Initial Operational Capability (IOC)		April 1987
(6)	(U) Fylingdales Radar IOC		FY 1990

*Date presented in FY 1987 Descriptive Summary

(U) Explanation of Milestone Changes

(4) (U) Delay in procurement start because of extensive preliminary negotiations with United Kingdom.

9. (U) COOPERATIVE AGREEMENTS: An agreement was signed with the United Kingdom on 13 October 1986 on the Fylingdales radar upgrade. The United Kingdom will pay for the facilities and operations and maintenance of the radar and the US will purchase the radar. Additionally, the facilities work will be performed by a United Kingdom subcontractor on the prime contract to be managed by the United States.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 12424F Title: SPACETRACK
DOD Mission Area: 332 - Strategic Surveillance and Warning Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		8,456	14,385	9,630	10,966	Continuing	N/A
2295	Ground-Based Electro-Optical Deep Space Surveillance System	3,471	4,061	1,300	1,400	Continuing	N/A
2296	Ground-Based Sensors	4,985	10,324	4,430	4,666	Continuing	N/A
3202	Air Force Maui Optical Station	*	*	3,900	4,900	Continuing	N/A

* Funding for this project is in Project 2296 until FY 1988

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Soviets continue to pursue a dynamic and expanding military space program, including an operational antisatellite (ASAT) system and satellite reconnaissance systems which are integrated with their ground forces. Our current space surveillance network (SPACETRACK) has [

] This program integrates near- and far-term operational systems into SPACETRACK in support of satellite attack warning and verification. [

] These research and development efforts will: (1) support the deployment of a five-site global ground-based electro-optical deep space surveillance system (GEODSS) [

] (2) provide [

] through the Pacific corridor with Pacific radars including the Defense Advanced Research Projects Agency (DARPA) Long-Range Tracking and Instrumentation Radar on Kwajalein and GPS-10 radar in the Philippines); (3) provide rapid and accurate calibration of SPACETRACK radars using the Navy Transit satellites; (4) upgrade the Air Force Maui Optical Station; Haystack and Kaena Point sites to support SPACETRACK space object identification, and operational satellite mission assessment and (5) provide extended range capability

for selected SPACETRACK radars. Mission need is documented in Air Defense Command Statement of Need 3-79 and Air Force Mission Element Need Statement for an antisatellite capability (validated by Secretary of Defense).

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
RDT&E	9,368	16,461	14,264	N/A	Continuing	N/A
Other Procurement	14,650	5,200	0	N/A	Continuing	N/A

EXPLANATION: (U) RDT&E reductions were caused by a need to fund higher priority operations and maintenance tasks.

4. (U) OTHER APPROPRIATION FUNDS ($ in thousands):

Other Procurement	5,737	5,549	1,777	1,636	Continuing	N/A
Military Construction	13,930	5,200	0	0	Continuing	27,580

5. (U) RELATED ACTIVITIES: SPACETRACK is part of the Space Defense Systems Program involving four functional areas: Antisatellite, Space Surveillance, Space System Survivability, and Command and Control. SPACETRACK is integrated with those programs which comprise the Space Defense Systems Program: PE 64406F, Space Defense System; PE 12450F, Space Defense Operations; PE 63438F, Satellite System Survivability: and PE 12311F, North American Aerospace Defense Cheyenne Mountain Complex Space Defense Systems. The baseline and technology for the Ground Based Electro-Optical Deep Space Surveillance (GEODSS) System and the SPACETRACK improved radar calibration, extended range and radar imaging upgrades were developed and demonstrated under PE 63428F.

6. (U) WORK PERFORMED BY: Program management is provided by Headquarters Space Division, Los Angeles AFS, CA (Project 2296), Headquarters Electronic Systems Division, Hanscom AFB, MA (Project 2295) and Rome Air Development Center, Griffiss AFB, NY (Project 3202). TRW Redondo Beach, CA, is the prime contractor for the GEODSS. GEODSS sub-contractors are ITEK (cameras), Lexington, MA; Contraves Georz (telescopes), Pittsburgh, PA; and Kentron (operations and maintenance) Honolulu, HI. Avco Everett Research Laboratories, Everett, MA, operates the Maui Optical Tracking and Identification Facility and conducts research and development at the Air Force Maui Optical Site. General Electric is extending the range of the Pirinclik, Turkey, FPS-79 radar. Western Space and Missile Center is Space Division's agent for Kaena Point SPACETRACK improvements. General systems engineering and technical support is provided by Lincoln Laboratory, Lexington, MA: Mitre Corporation, Bedford, MA; and Aerospace Corporation, Los Angeles, CA.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. Project: 2295, Ground-Based Electro-Optical Deep Space Surveillance (GEODSS) System: Provides a global network of five sites to optically detect, track and identify satellites in earth orbit at altitudes of 3,000 to 22,000 nautical miles and beyond. Deployment of first three sites and Program Management Responsibility Transfer were completed in FY 1983. The GEODSS Test System (GTS) was built to reduce risk in meeting Initial Operational Capabilities (IOCs) for the Diego Garcia and Portugal sites. Prime mission equipment (PME) and software unique to the Diego Garcia site continues to undergo test and evaluation. In FY 1986, construction of the Diego Garcia facility was completed. Beginning in FY 1986 and continuing into FY 1987, the PME and software unique to Diego Garcia site will be installed and checked out. Evaluation will be conducted on system enhancements such as addition of long wavelength infrared (LWIR) detectors, compensated imaging (visible) sensors and mobile GEODSS systems. In FY 1987, system enhancement evaluations will continue. These studies will include automated image processing, bistatic imaging system concepts and improved range resolution. In FY 1988 and FY 1989, the construction of the Portugal site will be completed and GEODSS equipment and software will be installed and checked out. [

] Cost estimates are based on historic data and are thus Category I (Comprehensive). Although the program is a multi-contract effort, the largest portion is with Lincoln Laboratories, a Federal Contract Research Center (FCRC). This is a continuing program.

B. Project: 2296, Ground-Based Sensors: This project provides the Research and Development (R&D) base for pre-planned improvements to the dedicated collateral and contributing radars. Developments [

] in space object identification and mission assessment capability, and improve surveillance support for space defense. These sensors provide [

] Upgrades to Kaena Point radar began in FY 1985 to improve the quality and timeliness of the communication system with North American Aerospace Defense (NORAD) Command and to increase its dedicated SPACETRACK operation time. Planning was completed to incorporate additional SPACETRACK requirements into the PAVE PAWS missile warning radar. The Improved Radar Calibration System (IRCS) program is nearing completion, with Pirinclik scheduled for completion in FY 1987. Refurbishment of the Pacific Barrier (PACBAR) III C-Band radar started in FY 1985 and will continue in FY 1987. In FY 1986, radar imaging improvement developments at Lincoln Laboratory/Haystack began. In addition, development will continue on providing a deep space real-time radar imaging capability at Lincoln Laboratory/Haystack. This effort will serve as a prototype for potential future incorporation into other selected radar sites. The tactical communications upgrades to the Hawaiian Kaena Point C-Band radar commenced as did the Haystack signal processing upgrade. In FY 1987, construction of the PACBAR III radar facility will begin. In FY 1987, an analysis program will continue to identify solutions for deficiencies identified in the Air Force Space Surveillance Architecture study. Alternative solutions include C-Band imaging radars for Kaena Point, Ascension Island and Antigua; and adding a deep space tracking capability to the SPACETRACK facility at Pirinclik. In FY 1988, the PACBAR III radar equipment for ... Saipan site will begin installation as the construction phase is completed. In FY 1989, PACBAR III installation ... be completed. Computer program integration and development and testing will begin. Cost estimates are based on

contractor estimates modified by the appropriate overhead and escalation factors. Considering the maturity of the program, this estimate is Category I (Comprehensive). This is a continuing program.

C. (U) Project: 3202, Air Force Maui Optical Station (AMOS): AMOS is a unique R&D facility for space surveillance and the development of electro-optical technology. As such, it supports critical DOD programs like space surveillance, antisatellite (ASAT) target assessment and the intelligence community. The support is provided through development programs, measurements programs and experimental programs. Satellite sensor evaluations are conducted to determine pointing references, to calibrate sensors, and to evaluate vulnerability and hardening studies. Satellite signatures are collected from a database and to evaluate satellite configuration changes for ASAT. Programs like ASAT are dependent upon development in areas such as active atmospheric compensation, target acquisition, target discrimination and target assessment. A series of site upgrades took place in FY 1987 to make state-of-the-art technology available to support the FY 1988 and FY 1989 efforts. The upgrades included several major changes including a Laser Beam Director (LBD). In FY 1988, we will fund for the LBD to support the TEAL RUBY sensor calibration program and other recommended new lasers which will provide a source of real-time, line-of-sight, atmospheric parameters such as water vapor and aerosol concentration and temperature profiles unavailable elsewhere. Additionally, the Compensated Imaging System (CIS) has demonstrated its ability to significantly improve atmospherically distorted images of space objects. In FY 1988 and FY 1989, compensated imaging and infrared imaging technology development will continue. The ASAT satellite signature database will also be updated. The CIS project was formerly a Defense Advanced Research Projects Agency (DARPA) program and transitioned to the Air Force in FY 1985. Funding in FY 1986 and 1987 is contained in Project 2296 of this program element. This is a continuing program.

8. (U) PROJECTS OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 12431F
DOD Mission Area: [ ]

Title: Defense Support Program (DSP)
Budget: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		65,038	113,022	103,807	95,214	Continuing	N/A
3624	DSP	65,038	113,022	103,807	72,820	Continuing	N/A
3625	DSP Follow-on[ ]	0	0	0	22,394	Continuing	N/A

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: [

] The system consists of[ ]satellites in geostationary orbital locations, two large processing stations, one Mobile Ground System (six Mobile Ground Terminals, six Mobile Communication Terminals, one Main Operating Base), one simplified processing station, one multi-purpose facility, and a ground communications network. [

]

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	77,540	138,178	95,429	N/A	Continuing	N/A
MISSILE PROCUREMENT	124,082	358,515	445,558	N/A	Continuing	N/A
OTHER PROCUREMENT	138,649	141,312	67,356	N/A	Continuing	N/A

EXPLANATION:
- (U) FY86 RDT&E decrease of $12.502 million due to several congressional reductions.
- (U) FY87 RDT&E decrease of $25.156 million due to several congressional reductions.
- (U) FY88 RDT&E increase of $8.378 million due to rephasing of the launch program.
- (U) FY86 Missile Procurement decrease of $6.861 million due to Gramm-Rudman and general congessional reduction.
- (U) FY87 Missile Procurement decrease of $80.378 million due to several congressional reductions.
- (U) FY88 Missile Procurement decrease of $53.715 million due to restructuring of satellite buy and directed reductions related to inflation, profit policy and contract support.
- (U) FY87 Other Procurement decrease of $43.493 million due to congressional reduction and reduced spares.
- (U) FY88 Other Procurement decrease of $45.504 million due to deferral of Mobile Communication Terminal Upgrade and reduced spares.

Program Element: 12431F
DoD Mission Area: [ ]

Title: Defense Support Program (DSP)
Budget Activity: 3 - Strategic Programs

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Missile Procurement:						
Funds	117,221	278,137	391,843	488,787	Continuing	N/A
Quantities (Satellites)	0	EOQ	1	2		
Other Procurement:						
Funds	137,649	97,819	21,852	10,833	Continuing	N/A
Quantities	Not Applicable.					
Operations and Maintenance (software)	38,148	46,664	50,589	51,483	Continuing	N/A

5. RELATED ACTIVITIES: Defense Satellite Communications System (P.E. 33110F and 33605F) provides primary communications routing for DSP data [ ] and will help provide Mobile Ground System communications. Space Boosters (P.E. 35119F) provides Titan 34D and Titan IV launch support. Space Launch Support Program (P.E. 35171F) will provide Inertial Upper Stages and any Space Shuttle flights for DSP missions. [ ] which will be the technical basis for the DSP Follow-on design pursued in this P.E.

6. WORK PERFORMED BY: Space Command and the Air Force Communications Command are the system operators and maintainers of the DSP ground stations. Air Force Systems Command's Space Division, Los Angeles Air Force Station, CA, has overall program management responsibility for development and acquisition. The Air Force Logistics Command, Wright-Patterson AFB, OH, provides engineering and logistics support. The Air Force Operational Test and Evaluation Center, Kirtland Air Force Base, NM, participates in test and evaluation of selected system segments. TRW, Redondo Beach, CA, is the prime contractor for the spacecraft and satellite integration. Aerojet Electrosystems Company, Azusa, CA, is the prime contractor for the infrared sensor, and the large processing station. [ ] IBM, Boulder, CO, is the prime contractor for all software efforts as well as the prime contractor on the Mobile Ground System. The Aerospace Corporation, El Segundo, CA, furnishes general systems engineering and integration for the DSP System Program Office.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable

Program Element: 12431F
DOD Mission Area: [ ]

Title: Defense Support Program (DSP)
Budget Activity: 3 - Strategic Programs

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3624, Defense Support Program

A. Project Description: This is an operational program in which replacement satellites include evolutionary improvements for performance and survivability. These improvements have been incorporated on satellites 14 and beyond, which are designated DSP-I models. The first DSP-I will be delivered in FY 1988 and will be launched based on operational need. Projections indicate this will occur late in FY 1988 or early FY 1989. The DSP-I is dual compatible, capable of launch by either the Titan IV or the Space Shuttle. Communications survivability will be improved by a satellite-to-satellite laser crosslink[ ]and by mission data message rebroadcast where the satellite transmits the[ ]directly to the users.[ ] An autonomous station-keeping capability will add to satellite on-orbit endurance. Ground processing survivability has been obtained by deploying a Mobile Ground System (MGS) consisting of six Mobile Ground Terminals (MGTs), which process the raw satellite data into[ ]six Mobile Communication Terminals (MCTs), which provide the primary, hardened, jam resistant link to the users, and other support vehicles to sustain long-term operations in the field. The replacement of the computer peripherals in the ground stations will be continued, as well as upgrading to the operational software to make it compatible with the improved satellite capabilities. Orbital operations support, satellite maintenance and other efforts associated with maintaining a[ ]structure will continue.

B. (U) Program Accomplishments and Future Efforts:

(1) FY 1986 Accomplishments: Initial Operational Test and Evaluation (IOT&E) was completed on the MGS. IOT&E demonstrated that the MGS met or exceeded user requirements for[ ] Efforts continued to correct the areas which the tests found needing correction such as software immaturity, maintenance reliability, and logistics support. The major upgrade to make the MGT compatible with DSP-I survivability features continued. The MGT version currently deployed can support only the pre-DSP-I design. Improvements included the development of: a hybrid Mission Data Message terminal to provide a threat secure commanding and internetting capability; equipment to receive and separate the multiplexed links from two satellites; adaptive equalization equipment and improvements to the phased array antenna system[ ]and software to support austere commanding, autonomous ephemeris and second color processing. Similar efforts for the fixed ground stations continued. Efforts also continued to insure the dual compatibility of DSP-I satellites with both the Titan IV and the Space Shuttle.

(2) FY 1987 Program: DSP satellite[ ] The SED satellites incorporate the larger focal plane as used in the DSP-I satellites. Work will continue on making DSP satellites dual compatible. Development and procurement wil continue for Mobile ... nd Terminal hardware and software upgrades required for compatibility with the survivability enhancements of

PE: 12431F

DSP-I. The Simplified Processing Station will also be made compatible with DSP-I. FY 1987 funds continue to support the Ground Communications Network upgrade which will relieve the current saturated condition and replace obsolete equipment.

(3) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The major portion of the 1988 activity involves launch vehicle and upper stage integration to insure dual launch compatibility, [ ] This includes integration onto two launch vehicles (Shuttle and Titan IV) and two upper stages (Inertial Upper Stage and Centaur) with DSP satellites. NASA and launch site support of integration are also included. Efforts will continue on the upgrades to the Mobile Ground System to make the processing and communications hardware compatible with DSP-I. Work will continue on revising the architecture of the ground station software. This software redesign will fully complement the new capabilities of DSP-I (e.g. processing of data communicated through the laser crosslink and processing of new sensor data). The software redesign effort will make use of the DOD common programming language, Ada. This effort also includes redesign of the off-line analysis and support programs used to maintain the software. It also develops and prototypes changes in the secure satellite commanding system hardware and the spacecraft simulator to be compatible with the new DSP-I satellites. The spacecraft simulator is used to check out satellite commands before they are actually sent to the satellite. Funding also provides for general systems engineering and integration. The cost estimates were generated by the Program Office using comptroller prepared Independent Cost Estimates, contractor inputs, an OSD directed Independent Cost Analysis completed in July 1985, inputs from other government agencies and previous experience on similar modifications. Cost estimates are considered to be Category II - mature.

(4) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Assuming that present Shuttle and Titan IV launch plans hold firm, the Air Force will launch two [ ] Efforts will continue on the upgrades to the Mobile Ground System to make the processing and communication hardware and software compatible with DSP-I. Work will continue on revising the architecture of the ground station software. This software redesign will fully complement the new capabilities of DSP-I (e.g. processing of data communicated through the laser crosslink and processing of new sensor data) making use of the Ada programming language. This effort also includes redesign of the off-line analysis and support programs used to maintain the software. It also completes changes in the secure satellite commanding system hardware for the Mobile Ground System to be compatible with the new DSP-I satellites. Funding also provides for general systems engineering and integration. The cost estimates are generated by the Program Office using comptroller prepared Independent Cost Estimates, contractor inputs, an OSD directed Independent Cost Analysis completed in July 1985, inputs from other government agencies and previous experience on similar modifications. These cost estimates are considered to be Category II - mature.

(5) (U) Program to Completion: This is a continuing program. Primary emphasis will be directed toward eliminating or minimizing operational employment deficiencies and vulnerabilities, insuring a launch capability through the use of either the Titan IV or the Space Shuttle, the development of a survivable DSP system through the upgrades to the Mobile Ground System and satellites, and insuring the adequacy of the ground station data

C. (U) Major Milestones:

	Milestones		Dates
(1)	(U) Initiation of Peripheral Upgrade		August 1983
(2)	[		]
(3)	(U) First Mobile Ground Terminal Delivery		August 1984
(4)	[		
(5)			
(6)			]
(7)	(U) Satellite #14 Delivery (First DSP-I)	*(1st Qtr CY 87)	2 Quarter FY 1988
(8)	(U) Successive Launches		As Required

*Date presented in FY 1987 Descriptive Summary.

(U) Explanation of Milestone Changes

(5) [ ]
(7) (U) Delivery slipped because contractor efforts were diverted to launch attempts and satellite storage incurred by resolution of booster problems.

9. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

Project: 3625, Defense Support Program Follow-on[ ]Full Scale Development (FSD))

A. Project Description: Since 1970 the Defense Support Program has provided data for[ ] The approach has used[ ]from synchronous satellites with data processing at large, fixed ground sites. The DSP Follow-on requirement will be met by the[ ]a system that will[ ]The[ ]program is currently under the direction of[ ]during the technology development. The Air Force will assume program responsibility with the start of FSD in FY 1989. [ ]

The decision to proceed with the[ ]Full Scale Development is independent from any[ ] The DSP Follow-on[ ]project will fulfill[ ] If a decision

is made [ ] the DSP Follow-on could be upgraded for that mission. The satellite constellation will provide a more [ ] system than its DSP predecessors, capable of functioning in the trans-attack and post-attack environment.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Not applicable.

(2) (U) FY 1987 Program: Not applicable.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Not applicable.

(4) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: FY 1989 will be the initiation of Full Scale Development (FSD) for the satellites and supporting ground stations. The program will start design efforts for two RDT&E satellites for flight in [ ] The Advanced Development Model which will demonstrate the technology to be employed in these two prototypes is funded by [ ] and is planned for [ ] The cost estimates were generated by the Program Office using contractor inputs, inputs from other government agencies and previous experience on similiar development efforts. Cost estimates are considered to be Category IV - Planning.

(5) (U) Program To Completion: This is a continuing development effort. Primary emphasis will be directed toward eliminating or minimizing operational employment deficiencies and vulnerabilities, the development of a survivable system and insuring the adequacy of the ground stations with an efficient, but cautious transition from the DSP coverage.

C. Major Milestones:

Milestones	
(1) Air Force Assumes [ ] FSD	1 Quarter FY 1989

10. (U) COOPERATIVE AGREEMENTS: Not applicable.

Budget Activity: 3, Strategic Programs
Program Element: 12431F, Defense Support Program (DSP)

Test and Evaluation Data

1. Development Test and Evaluation (DT&E): The Defense Support Program (DSP) was designed, developed, tested and then deployed as an operational system in the early 1970s. The system is a classified space program

information to the National Command Authorities and military commanders for decision-making purposes. Combined Development Test and Evaluation/Initial Operational Test and Evaluation (DT&E/IOT&E) on the prototype Simplified Processing Station was completed in 1978. Over the next several years, four system upgrades will require DT&E. They are the Sensor Evolutionary Development

the Mobile Ground System; the Peripheral Upgrade Program; and the DSP-I satellite upgrades.

The Sensor Evolutionary Development satellites have more infrared detection cells in the focal plane.

The sensor portion of the satellite is being produced by Aerojet ElectroSystems Company,

and the spacecraft is being produced and integrated by TRW, Incorporated. DT&E has been performed on one satellite at the Aerojet ElectroSystems Company and TRW facilities,

(U) The purpose of the Mobile Ground System is to provide survivability to the Defense Support Program ground processing and communication elements through mobility. It will use the same computer hardware and software as the Simplified Processing Station. The prime contractor is IBM Corporation. DT&E was accomplished at the system level to ensure that the Mobile Ground System could meet its mobility and communication requirements prior to IOT&E start in September 1985.

(U) The Peripheral Upgrade Program (PUP) will replace all peripheral equipment at the support sites and the operational large processing stations. Replacements provide processing and display capability for the DSP-I satellite improvements and preclude equipment obsolescence and non-supportability. The PUP contract was awarded to Aerojet ElectroSystems Company in September 1983. DT&E was completed in 1986 for the CONUS Ground Station, and will be completed in 1987 for the Overseas Ground Station. The existing system must remain operational during the peripheral replacement and testing.

Budget Activity: 3, Strategic Programs
Program Element: 12431F, Defense Support Program (DSP)

DSP-I satellites include several survivability upgrades: a satellite-to-satellite crosslink capability to reduce overseas ground station and communication vulnerability, [ ] a mission data message rebroadcast capability to reduce communication vulnerability, and an autonomous ephemeris capability to allow the satellite to remain operational without regular updates from fixed ground stations. Development of these satellites started in late fiscal year 1981. The first will be delivered in 1988. The DT&E program for these upgrades will be similar to that on the Sensor Evolutionary Development System, including DT&E of the satellite, ground station hardware and software modifications.

2. (U) Operational Test and Evaluation (OT&E):

Mobile Ground System (MGS). The Air Force Operational Test and Evaluation Center (AFOTEC) IOT&E of the DSP Mobile Ground System (MGS) started on 30 September 1985 and was completed on 31 March 1986. Testing was supported by Air Force Systems Command (AFSC) (Space Divison), Air Force Communications Command (AFCC), Air Force Space Command (AFSPACECOM), and the [ ] command centers. MGS IOT&E was conducted at the Main Operating Base (MOB), [ ] For field tests, the MGS was deployed from three to 14 days up to 300 miles from the MOB. During deployments, test team members accompanied the MGS in order to obtain firsthand knowledge of system's capabilities and limitations under realistic tactical field conditions. Additionally the MGS was deployed to [ ] for a 14 day period.

(U) An MGS convoy consists of two prime elements: a Mobile Ground Terminal (MGT); and a Mobile Communications Terminal (MCT). While deployed, MGSs are supported by crew messing, crew quarters, field maintenance, fuel tanker, and two security police vehicles. The MCTs employed in the IOT&E and now deployed operationally are termed Limited Communications Vehicles (LCVs), as they do not fully meet MGS mobility, hardening or suitability requirements. Funds were cut which were to procure fully capable MCTs in FY88. The LCV consists of an Army-developed Jam-Resistant Secure Communications Terminal (JRSCT) mounted on an MGT transportation subsystem. The MGS was operated and maintained during IOT&E by Air Force personnel supplied by AFSPACECOM and AFCC.

The MGS convoys demonstrated the capability to operate with a high degree of mission success while deployed to distances of several hundred miles from the MOB. [

]

Budget Activity: 3, Strategic Programs
Program Element: 12431F, Defense Support Program (DSP)

Operational suitability was marginal due to poor mission reliability, inadequate logistics supportability, lack of hardness maintenance/surveillance program, and lack of software maturity. The deficiencies are being corrected via service reports and subsequent corrective actions. None of these prevented the MGS from being used operationally by AFSPACECOM.

Sensor Evolutionary Development (SED). Testing is in progress for the Air Force Space Command (AFSPACECOM)conducted, Air Force Operational Test and Evaluation Center (AFOTEC)-monitored IOT&E of SED satellite 6R and associated ground station software upgrades. Original time frame for SED IOT&E was April 1985 through November 1986. However, the delay in launching satellite 5R has resulted in this testing being put on hold. Interim reports exist for testing at the CONUS Ground Station (CGS) and Mobile Ground System (MGS). The primary purpose of this IOT&E is to ensure that the SED meets the current operational mission capability without any degradation to the DSP. To bring the SED technology on line as soon as possible, IOT&E at the

was divided into Above-the-Horizon (ATH) and Below-the-Horizon (BTH) sections. The SED CGS BTH IOT&E, completed May 1985; SED CGS ATH IOT&E completed April 1986; and SED MGS BTH completed March 1986 concluded that SED provided a satisfactory replacement for existing DSP assets. The remaining phases of IOT&E will be conducted at the Overseas Ground Station (OGS), and the Simplified Processing Station (SPS).

(U) Peripheral Upgrade Program (PUP). A three-phase test program is in progress for the Air Force (AFSPACECOM)-conducted, Air Force (AFOTEC)-monitored IOT&E of the DSP Peripheral Upgrade Program. Each phase corresponds to testing at the multipurpose facility (MPF), CGS and OGS. Testing is scheduled for January 1986 through June 1987. The MPF testing, completed in March 1986, surfaced minor software problems which were being fixed when the second phase was being started. The CGS phase started when one of the three computer strings was tested from April to May 1986. The software for the second string was loaded and OT&E began in June 1986, with expected completion in December 1986. Expected completion of third string testing is mid-March 1987. OGS installation and testing will be completed by September 1987.

Survivable Defense Support Program Satellites (DSP-I). Test planning is in progress for the AFOTEC-conducted IOT&E of the survivable Defense Support Program (DSP-I). The DSP-I is a new generation satellite designed to increase satellite survivability and reduce dependence on fixed ground resources. Main elements to be tested in support of enhanced survivability for DSP are the Mobile Ground System and the Laser Crosslink Subsystem. Testing is now being keyed to the

The test program is based on the conduct of a combined DT&E/IOT&E phase followed with a dedicated IOT&E test phase at the operational sites. The IOT&E phases will include survivability studies, DT&E monitoring, early on-orbit testing, DT&E/IOT&E testing and site IOT&E.

Budget Activity: 3, Strategic Programs
Program Element: 12431F, Defense Support Program (DSP)

(U) Ground Communications Network (GCN) Upgrade. The GCN upgrade is a multiphase project forecast for FY85-89. The GCN port expansion project was initiated to increase the number of high speed user data ports and add Advanced Data Communications Control Procedures (ADCCP) message protocol capability. This IOT&E is being conducted by SPACECMD and monitored by AFOTEC. The port expansion IOT&E was performed March through December 1985. Another phase of the GCN upgrade is the communication subsystem data entry display program. This phase will replace the old Sigma computers at the Data Distribution Center with two new computers which will function as a computer manager to distribute data to low speed users and from low speed sources. This also replaces the old user terminals with current technology terminals.

(U) OT&E Reports Published:

(U) Sensor Evolutionary Development (SED) for Large Processing Station (LPS), Simplified Processing Station (SPS), and Mobile Ground System (MGS) IOT&E Plan, November 1984, (S), HQ AFSPACECOM/XPW.

(U) Survivable Defense Support Program (DSP-I) IOT&E Plan, December 1984, (S), HQ AFOTEC/TES.

(U) SED CONUS Ground Station (CGS) Below-the-Horizon (BTH) IOT&E Interim Test Report, May 1985, (S), HQ AFSPACECOM/XPW.

(U) SED CGS Above-the-Horizon (ATH) IOT&E Interim Test Report, April 1986, (S), HQ AFSPACECOM/XPW.

(U) Mobile Ground System (MGS) IOT&E Plan, September 1985, (S), HQ AFOTEC/TES.

(U) Mobile Ground System (MGS) IOT&E Final Report, June 1986, (S), HQ AFOTEC/TES.

(U) SED MGS BTH IOT&E Interim Test Report, November 1986, (S), HQ AFSPACECOM/XPW.

Budget Activity: 3, Strategic Programs
Program Element: 12431F, Defense Support Program (DSP)

3. (U) System Characteristics:

Characteristics	Objectives	Demonstrated

Current Operational System

Sensor Evolutionary Development and Advanced Atmospheric Burst Locator Improvements

(U) DSP-I Improvements

Satellite-to-satellite crosslink
Mission data message rebroadcast capability
Two color focal plane
Autonomous ephemeris

4. (U) Current Test and Evaluation (T&E):

T&E Activity (Past 12 Months)

Event	Planned Activity	Actual Date	Remarks
(U) DSP-I IOT&E	Dec 84 - Sep 86	Dec 84 - Oct 86	Survivability studies and analysis phase of DSP-I testing.
(U) Mobile Ground System (MGS) IOT&E	Sep 85 - Feb 86	Sep 85 - Mar 86	
(U) Sensor Evolutionary Development (SED) CONUS Ground Station (CGS) Above-the-Horizon (ATH)	3 Jan - 31 Jan 86	3 Jan - 31 Jan 86	Above the horizon portion of phase I SED testing.
(U) SED MGS Below-the-Horizon (BTH)	Sep 85 - Feb 86	Sep 85 - Mar 86	MGS Phase of SED IOT&E conducted during MGS IOT&E
(U) Peripheral Upgrade Program (PUP) IOT&E Phase I Multipurpose Facility (MPF)	Dec 85 - Jun 86	Jan 86 - Mar 86	
(U) PUP IOT&E Phase II CGS	Apr 86 - Nov 86	Apr 86- 2nd Qtr FY87	

T&E Activity (Next 12 Months)

Event	Planned Date	Remarks
(U) Test and Evaluation Master Plan (TEMP) Approval	Jan 87	
(U) PUP IOT&E Phase II Overseas Ground Station (OGS)	Mar 87 - Sep 87	Three 30 day test periods.
(U) GS-14 IOT&E	Jan 87 - Feb 88	IOT&E performed at CGS and OGS.
(U) SED Simplified Processing Station (SPS) IOT&E	4th Qtr FY87	Dates are dependent on launch of satellite 5R.
(U) GCN Upgrade IOT&E	Sep 87	30-day test at all locations at the same time.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 12432F
DOD Mission Area: 332 - Strategic Surveillance and Warning

Title: Sea Launched Ballistic Missile (SLBM) Radar Warning Systems
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		6,980	18,059	20,313	10,175	Continuing	N/A

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The existing SLBM Radar Warning System consists of PAVE PAWS sites at Otis ANGB, MA, and Beale AFB, CA, the Perimeter Acquisition Radar Attack Characterization System radar in North Dakota and the FPS-85 radar at Eglin AFB, FL. The system presently covers most of the normally observed Soviet submarine patrol areas.

As a result, the PAVE PAWS system is being expanded and upgraded to close gaps in coverage to the Southeast and Southwest of the United States and to

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	8,025	19,752	20,728	N/A	Continuing	N/A
Other Procurement*	13,948	126,366	3,778	N/A	Continuing	N/A

*Includes spares

EXPLANATION: (U) FY 1987 due to Congressional action.

Program Element: 12432F
DOD Mission Area: 332 - Strategic Surveillance and Warning

Title: Sea Launched Ballistic Missile (SLBM) Radar Warning Systems
Budget Activity: 3 - Strategic Programs

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Other Procurement:						
Funds	13,506	99,402	2,079	767	Continuing	N/A
Quantities	Not Applicable					
Military Construction:						
Funds	3,376	0	0	0	Continuing	N/A

5. RELATED ACTIVITIES: The PAVE PAWS SLBM Early Warning System is part of the national system for Tactical Warning and Attack Assessment. It provides confirmation of initial launch detection information provided by the [ ] and complements the information provided by the Ballistic Missile Early Warning System (PE 12423F) and SPACETRACK (PE 12424F).

6. (U) WORK PERFORMED BY: The prime contractor is Raytheon Corporation, Wayland, MA. Major subcontractors are Control Data Corporation, Minneapolis, MN (hardware) and TRW, Redondo Beach, CA (software). The program is managed by Air Force Systems Command's Electronic Systems Division, Hanscom AFB, MA, in conjunction with North American Aerospace Defense Command (NORAD), Space Command and Air Force Communications Command. General system engineering is being provided by Mitre Corporation, Bedford, MA.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 12432F, SLBM Radar Warning Systems

A. Project Description: The PAVE PAWS expansion program is deploying two new phased array radars, one each in the Southeast (SE) at Robins AFB, GA, and in the Southwest (SW) near Goodfellow AFB, TX. These new sites will complement the two sites now in operation in the Northeast at Otis ANGB, MA, and the Northwest at Beale AFB, CA. Together with the Perimeter Acquisition Radar Attack Characterization System in North Dakota, they will complete the planned five-site phased array SLBM warning network. The two new PAVE PAWS sites will initially be deployed in a configuration having the same radar power output as the sites at Otis and Beale. This initial deployment will close the gaps in warning coverage to the SE and SW. It will provide a significant improvement in tactical warning capability and will permit closing of the MacDill AFB, FL, FSS-7 radar site. Beginning in FY 1987, the SE site will be increased in radar power output by 10 dB. These power upgrades will extend the maximum range of the system from less than [ ]

Program Element: 12432F

DOD Mission Area: 332 - Strategic Surveillance and Warning

Title: Sea Launched Ballistic Missile (SLBM) Radar Warning System

Budget Activity: 3 - Strategic Programs

[ ] In addition, the Northeast (NE) and Northwest (NW) sites will undergo a computer upgrade to provide for commonality with the new Southeast (SE) and Southwest (SW) sites. These changes will allow the PAVE PAWS system to detect and track smaller objects,] and provide improved detection probability. The power upgrade to the SE site will also allow it to perform the spacetracking functions of the obsolescent FPS-85 radar at Eglin AFB, FL, and permit subsequent closure of the AN/FPS-85.

B. (U) Program Accomplishments And Future Efforts:

(1) (U) FY 1986 Accomplishments: In-plant testing on equipment and software for the SE site was completed and installation and checkout took place at Robins AFB, GA. On-site testing commenced, leading to a projected Initial Operational Capability (IOC) early in FY 1987. The SW site equipment went through in-plant testing, followed by shipment to the operational location near Goodfellow AFB, TX, for installation, checkout and on-site testing.

(2) (U) FY 1987 Program: On-site testing will be completed and the SE site became operational in November 1986. On-site testing will be completed and the SW site will become operational in May 1987. Also in 1987, contract options will be executed to provide for power upgrade to the SE site. New automated data processing (ADP) equipment will be acquired for the NE and NW sites to provide for system-wide commonality. System engineering, software development and in-plant testing will be conducted in support of these system upgrades.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: System engineering and in-plant software development and hardware testing at the subsystem/system levels will continue for the three upgrades initiated during FY 1987. Software development is required to permit the SE site to accommodate a power upgrade and to expand the mission of that site to assume space tracking responsibilities. When the SE site power upgrade is completed in FY 1989, the SE site will assume the responsibilities of the AN/FPS-85 radar at Eglin AFB, Florida, permitting the closure of this obsolescent, costly-to-maintain system. Software development is also required to implement the ADP upgrades at the NE and NW sites which will result in system-wide hardware/software commonality. Cost estimates are Category I, Comprehensive.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: On-site testing for the PAVE PAWS upgrade will continue through FY 1989. The SE site upgrade will become operational in FY 1989. Correction of any discrepancies and preparation for management transfer to the operators and maintainers for the SE and SW sites will continue. Cost estimates are Category I, Comprehensive.

(5) (U) Program to Completion: The SE and SW upgrades will become operational in FY 1990. This is a continuing program; subsequent efforts will be implemented as necessary to accommodate evolving Tactical Warning/Attack Assessment needs.

C. (U) Major Milestones:

Milestones	Dates
(1) (U) Contract Award	November 1983
(2) (U) SE Site Initial Operational Capability (IOC)	November 1986
(3) (U) SW site IOC	May 1987
(4) (U) SE site power upgrade complete	September 1989
(5) (U) NE site computer upgrade complete	December 1989
(6) (U) NW computer upgrade complete	March 1990

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 12433F
DOD Mission Area: 332-Strategic Surveillance and Warning

Title: NUDET Detection System (NDS)
Budget Activity: 3-Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		18,674	25,468	10,397	10,932	Continuing	N/A

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Strategic Air Command and Aerospace Defense Command require a highly survivable capability to detect, locate, and report any nuclear detonation (NUDET) on a global basis in near real time. The NUDET Detection System (NDS) (formally known as the Integrated Operational NUDET Detection System (IONDS)) consists of sensors on the operational 18-satellite Navstar Global Positioning System (GPS). NUDET information supports post-impact selection of appropriate retaliatory options in response to a nuclear attack against North America, as well as strike confirmation, and damage assessment. NUDET detection information is vital to the effective management of U.S. forces through the trans- and post-attack phases of a nuclear conflict. Reports to command centers of weapon effectiveness will be vital in managing strategic reserve forces and re-establishing a command structure. NDS data could be a major information component during negotiations to terminate a nuclear conflict.]

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	20,015	31,346	9,717	N/A	Continuing	N/A
Missile Procurement	22,299	26,325	N/A	N/A	Continuing	N/A
Other Procurement	0	11,630	N/A	N/A	Continuing	N/A

EXPLANATION: (U) The increase in FY 1988 funds the development of second sources of key satellite boxes to support the competitive development of NDS equipped GPS replenishment satellites and a user terminal reliability development and improvement program. The decrease in FY 1986 was due to Gramm-Rudman reductions. The decrease in FY 1987 was due to Congressional reductions relating to the delays caused by the Shuttle accident.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Missile Procurement						
Funds	20,499	9,338	11,900	0	Continuing	N/A
Quantities	9	8	4	0		
Other Procurement						
Funds	0	2,798	13,891	13,960	Continuing	N/A
Quantities	0	0	2	2		

5. RELATED ACTIVITIES: NDS sensors are flown on all Navstar Global Positioning System (GPS) satellites (PE 35165F) beginning with the GPS launch in July 1983. Development and production of the X-ray and optical Nuclear Detection (NUDET) sensors for NDS are funded by the Department of Energy (DOE), with support from The X-ray and optical sensors are integrated into the GPS satellite under PE 31357F. Production of the airborne NDS terminals, to begin in FY 1989, will be funded in the Worldwide Airborne Command Post, PEs 11312F and 32015F.

6. WORK PERFORMED BY: System development and procurement is accomplished by Air Force System Command's Space Division, Los Angeles AFS, CA Rockwell International, Seal Beach, CA, integrates the NDS sensors on GPS satellites and produces the Electromagnetic Pulse (EMP) sensor. Ford Aerospace and Communications Corporation, Palo Alto, CA, and the Aerospace Corporation, El Segundo, CA, provide systems engineering support. Sandia National Laboratories, Albuquerque, NM, and Los Alamos National Laboratory, Los Alamos, NM, are under contract to the Department of Energy (DOE) to produce the X-ray and optic nuclear detonation sensors. Texas Instruments, Dallas, TX, is developing and will produce the Ground/Airborne user terminals. E-Systems, Garland, TX, is developing the EMP receiver/processor for the satellite.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 12433F, NUDET Detection System

A. Project Description: The NDS payload consists of X-ray, optical, and electromagnetic pulse (EMP) sensors on the operational eighteen satellite GPS constellation. These sensors, when coupled with the extremely precise GPS timing capability, will provide location of nuclear bursts worldwide This project develops and integrates the electromagnetic pulse sensor into the GPS satellite and develops the Ground/Airborne terminals to provide authorized users direct receipt of NDS nuclear detonation data. The data is also cross-linked to other GPS/NDS satellites which act as relay points. This cross-linking of information, when used with 18 satellites, will

allow a user on one side of the earth to receive detonation data from the opposite side. It also provides multiple redundancy of the data transmission for increased system availability and survivability. A broad range of users (National Command Authorities, Strategic Air Command, Aerospace Defense Command, other Unified and Specified Commands, and the [ ] will receive nuclear detonation (NUDET) data direct from the spacecraft on the precise location, yield, count, time, and height of burst.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: NDS Payloads were installed on the final four validation phase Global Positioning System (GPS) spacecraft. The last development satellite was launched in October 1985. The electromagnetic pulse (EMP) sensor, along with the DOE developed sensor are being integrated onto the GPS spacecraft. EMP sensor tests continue. Problems found during the NDS user terminal Critical Design Review in late 1985 with antenna packaging and receiver software design were resolved. The NDS terminal design continued with initial testing on an engineering model antenna. Aircraft interface engineering began.

(2) (U) FY 1987 Program: The FY 1987 program will complete development and testing of the electromagnetic pulse (EMP) sensor. NDS user terminal development will continue. Mission software tests will be performed to reduce risks associated with terminal integration with ground fixed/mobile and airborne command posts. Engineering model tests will continue verifying software/hardware integration.

(3) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Integration efforts for the EMP sensor and NDS payload will continue on the GPS production spacecraft. An effort will begin to develop second sources of key satellite components. These second sources will provide the industrial base to compete the NDS equipped GPS replenishment satellite production scheduled to start in FY 1991. The NDS user terminal development effort will continue. A NDS development terminal will be installed at [ ] in support of Development Test and Evaluation/Initial Operational Test and Evaluation (DT&E/IOT&E) testing. Procurement of user ground terminals for high priority users will be initiated. Aircraft integration engineering for the EC-135 aircraft NDS terminal will continue. A NDS terminal reliability improvement program will begin. Costs for the NDS satellite sensor payload are based on previous NDS satellite sensor payload development efforts and are category II, mature, estimates. NDS user terminal development costs are based on similar terminal developments and contract costs, and are category II, mature, estimates.

(4) FY 1989 Planned Program and Basis For FY 1989 RDT&E Request: Engineering development will begin on the NDS payload for the GPS replenishment satellites. A user terminal will be completing DT&E/IOT&E testing at [ ] Aircraft modification activities will begin to support the DT&E/IOT&E testing on the EC-135. Production activities will continue. The user terminal reliability program will continue. The same cost estimate categories apply as in FY 1988.

(5) (U) Program to Completion: This is a continuing program. NDS sensor design and production are keyed to the GPS satellite schedule. The user terminal development program will conclude in early 1990 and NDS user terminal production will continue satisfying ground and airborne terminal users. Outyear RDT&E funds will support the development of fixes for deficiencies found during DT&E/IOT&E and required system operational improvements.

C. (U) Major Milestones:

	Milestones		Dates
(1) (U)	Defense Systems Acquisition Review Council II		June 1979
(2) (U)	Begin Satellite Production		August 1982
(3) (U)	Launch 1st NDS Equipped Global Positioning System Spacecraft		July 1983
(4) (U)	Launch 1st Operational Satellite	*(1st Quarter FY 1987)	1st Quarter FY 1989**
(5) (U)	Start User Terminal Initial Operational Test and Evaluation (EC-135)		1st Quarter FY 1990
(6) (U)	Achieve Worldwide 2-Dimensional NUDET Location Capability	*(1st Quarter FY 1988)	4th Quarter FY 1989**
(7) (U)	Achieve Worldwide 3-Dimensional NUDET Location Capability	*(1st Quarter FY 1989)	4th Quarter FY 1990**

* Date presented in the FY 1987 Descriptive Summary.
** Launch dates and NDS capabilities are based on the Delta II contractor's proposal and the current DOD launch manifest.

(U) Explanation of Milestone Changes

(4) (6) (7) (U) First launch of an operational satellite and NDS operational capabilities slipped because of 24 month Shuttle standdown.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 12436F
DOD Mission Area: 391 - Strategic Information Systems

Title: Command Center Processing and Display System
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		12,576	25,699	32,052	38,064	Continuing	N/A

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Strategic Air Command (SAC) Statement of Operational Need 1-80 identified the requirement to upgrade the current Command Center Processing Display System (CCPDS). [ ] A CCPDS-Replacement (CCPDS-R) is necessary to correct current deficiencies and provide needed information for tactical warning. CCPDS-R consists of new computer hardware, software, display devices, and consoles for receipt and processing of ballistic missile Tactical Warning/Attack Assessment (TW/AA) information at the North American Aerospace Defense (NORAD) Cheyenne Mountain Complex (NCMC) missile warning center and command post and the Headquarters SAC command post to enable the Commander-in-Chief (CINC) US Space Command and CINC-NORAD to provide tactical warning assessments to the National Command Authority (NCA) and enable CINC-SAC to protect US strategic forces. Common display of attack data will be provided to the NCA, CINC-NORAD, CINC-SAC, CINC-US Space Command, CINC-Air Force Space Command, and other CINCs through the Attack Warning Processing and Display System (AWPDS) at the NORAD command post, SAC command post, National Military Command Center, Alternate National Military Command Center, and other command centers. CCPDS-R and AWPDS are essential to commanders and the NCA in making decisions related to nuclear force survival, execution of US strategic forces through[ ]and the use of strategic reserve forces during peacetime, pre-attack, and trans-attack phases of conflict. The AWPDS will also provide common TW/AA direct sensor data to survivable mobile command centers.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	14,430	27,027	24,789	N/A	Continuing	N/A
Other Procurement	2,552	2,110	29,360	N/A	Continuing	N/A

EXPLANATION: (U) FY 1986 is lower than planned due to the delay in CCPDS-R Full-Scale Development/Production contract award caused by the addition of AWPDS requirements in the request for proposal. This delay and the additional requirements have also increased FY 1988 RDT&E budgetary requirements to keep the program Initial Operational Capability on schedule. FY 1988 Other Procurement funds were moved to FY 1989 to match the current program schedule.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Other Procurement:						
Funds	4,002	2,052	3,124	27,491	Continuing	N/A
Quantities	Not Applicable					

5. (U) RELATED ACTIVITIES: PE 12313F, Ballistic Missile Tactical Warning/Attack Assessment (TW/AA) Support, funded development of the system operations concept, system hardware and software acquisition specifications, request for proposal, and the statement of work documentation during FY 1983. PE 12310F, NCMC-TW/AA Systems, provides the major interface within the North American Aerospace Defense (NORAD) Cheyenne Mountain Complex (NCMC) and the planned new Strategic Air Command (SAC) command posts by providing upgrades to other command control systems. Together PE 12310F and PE 12436F provide the core computer replacement systems which support the Joint Chiefs of Staff approved Integrated Tactical Warning and Assessment Architecture.

6. (U) WORK PERFORMED BY: The effort is managed by Air Force Systems Command's (AFSC) Electronic Systems Division (ESD), Hanscom AFB, MA. Competitive design contracts have been awarded to TRW and Ford Aerospace and Communications Corporation, both of Colorado Springs, CO. A prime contractor has not yet been selected for Full Scale Development/Production but Competitive Source Selection should result in an award in March 1987. Preliminary acquisition documentation and systems engineering is conducted by Mitre Corporation, Bedford, MA.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY1989:

(U) Project: 12436F, Command Center Processing and Display System (CCPDS)

A. (U) Project Description: The CCPDS-Replacement (CCPDS-R) is developing a replacement to the ballistic missile TW/AA command control system at the NCMC and the SAC command post. At SAC, CCPDS-R will be housed in the Offutt Processing and Correlation Center (OPCC) (Reference PE 12310F). CCPDS-R will enable the Commander-in-Chief (CINC) NORAD to provide the National Command Authority with tactical warning and assessment. CCPDS-R at the OPCC will enable CINC-SAC to perform force management functions and provides a second, yet austere, peacetime, pre-attack, and trans-attack fixed command center for the Integrated Tactical Warning and Assessment Architecture. CCPDS-R has completed the Competitive Design Phase and is currently in Competitive Source Selection for Full-Scale Development/Production to fully replace and automate the ballistic missile TW/AA system. The development will initially

(Block A) incorporate all the hardware and software capabilities necessary to satisfy the Tactical Warning/Attack Assessment requirements at the North American Aerospace Defense (NORAD) Cheyenne Mountain Complex (NCMC) and Offutt Processing and Correlation Center (OPCC). The second phase (Block B) will complete the Headquarters Strategic Air Command (SAC) unique mission requirements to permit US strategic force management. The Attack Warning Processing and Display System (AWPDS) will follow these developments and, in coordination with other upgrades of the architecture (Reference PE 12310), will provide common displays of Integrated Tactical Warning and Assessment data to all users. Eventually AWPDS will provide correlated missile, space, air defense, and intelligence information. However, current budgeting only includes automated ballistic missile warning data with the balance manually input from other command centers. In addition, the basic computer hardware and software effort is structured to permit automated upgrades of air defense and space warning data in the future.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: The competitive design for the Command Center Processing and Display System Replacement (CCPDS-R) effort was completed and a Full Scale Development/Production Competitive Source Selection was planned and executed.

(2) (U) FY 1987 Program: The CCPDS-R Full-Scale Development/Production contractor will be selected to design, develop, and test computer hardware and software. Computers, peripherals, and software will be designed and developed for operations at the NCMC and the OPCC. Testing of common computer programs, structured in a modular fashion for easy maintenance and modification, will begin.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: CCPDS-R Block A will complete major hardware and software design reviews. System testing will begin and final plans for initial operational test and evaluation will be conducted. Final software designs for Block B, SAC unique functions, will be completed. Development and definition of standard Integrated Tactical Warning and Assessment displays for the AWPDS for use by the National Command Authority and worldwide nuclear commanders will be initiated. This effort will be the first increment in procurement of the AWPDS. The FY 1988 CCPDS-R cost estimate is Category III, budgetary, based on an October 1986 update to an original combined bottoms-up and parametric Independent Cost Analysis completed in FY 1985. The AWPDS budget is Category IV, based on a user and program office initial estimate.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: CCPDS-R Block A will be installed and complete an extensive initial operational test and evaluation. AWPDS standard displays will be fully incorporated into the program. CCPDS-R Block B, SAC unique functions, will begin software testing. The SAC CCPDS-R at the OPCC will be installed and start incremental testing. The FY 1989 program cost is based on the same criteria as in paragraph (3) above.

(5) (U) Program to Completion: This is a continuing program. The Command Center Processing and Display System-Replacement (CCPDS-R) upgrade of automated ballistic missile tactical warning and assessment functions at the North American Aerospace Defense (NORAD) Cheyenne Mountain Complex (NCMC) is scheduled for completion in early FY 1992. The Block B effort will be completed by late FY 1992. Program budgetary limitations will delay Attack Warning Processing and Display System (AWPDS) initial operational capability until late FY 1991. AWPDS will not be completed until FY 1995 on the current schedule.

C. (U) Major Milestones:

		Milestones		Dates
(1)	(U)	Strategic Air Command Statement of Operational Need (SON) 1-80 validated (CCPDS-R)		May 1980
(2)	(U)	Design Definition Contract Award		August 1985
(3)	(U)	Headquarters Air Force Space Command SON 10-85 validated (AWPDS)		November 1986
(4)	(U)	Full-Scale Development/Production Contract Award and CCPDS-R Block A Start	*(August 1986)	March 1987
(5)	(U)	CCPDS-R Block B Start	*(May 1987)	March 1988
(6)	(U)	CCPDS-R Block A Initial Operational Capibility (IOC)	*(4th Quarter FY 1989)	September 1990
(7)	(U)	CCPDS-R Block B IOC (System Full Operational Capability)	*(1st Quarter FY 1991)	April 1992
(8)	(U)	AWPDS IOC		June 1991
(9)	(U)	AWPDS Full Operational Capability		FY 1995

* Data presented in FY 1987 Descriptive Summary

(U) Explanation of Milestone Changes:

(4) (U) Award delayed due to addition of AWPDS fixed sites.
(5), (6) & (7) (U) More definite identification of milestones based on current award schedule.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 33131F
DOD Mission Area: 331 - Strategic Command and Control

Title: Minimum Essential Emergency Comm Network (MEECN)
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		73,802	60,222	55,598	34,231	Continuing	N/A
2832	Very Low Frequency/Low Frequency (VLF/LF) Improvements	51,399	32,533	42,140	23,021	Continuing	N/A
2834	Ground Wave Emergency Network	22,403	27,689	13,458	11,210	Continuing	N/A

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This element is the Air Force portion of a continuing program supporting the Chairman, Joint Chiefs of Staff, who is responsible for delivery of decisions of the National Command Authority in a precise and timely manner[ ] Current emphasis is on improved command, control and communications to improve survivability, endurability and performance under adverse nuclear and jamming conditions. MEECN VLF/LF improvements project consists of communication systems specifically designed[ ] The MEECN GWEN project provides a communications system specifically designed for command and control of strategic forces in preand early trans-attack phases of conflict. Communications in the VLF and LF region of the spectrum have attributes useful in strategic communications. These include low ambient propagation loss, significant penetration of sea water, and good performance in a nuclear disturbed environment.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	99,526	92,527	57,947	N/A	Continuing	N/A
Aircraft Procurment	800	0	86,500	N/A	Continuing	N/A
Missile Procurement	8,500	0	10,300	N/A	Continuing	N/A
Other Procurement	19,841	123,408	16,144	N/A	Continuing	N/A

Program Element: 33131F | Title: Minimum Essential Emergency Comm Network (MEECN)
DoD Mission Area: 331 - Strategic Command and Control | Budget Activity: 3 - Strategic Programs

EXPLANATION: (U) FY 1986 RDT&E decrease of $25,724 thousand was due to $15,000 thousand appropriated by Congress for Miniature Receive Terminal (MRT) but never authorized and $10,724 thousand reduction due to Congressional reductions and programmatic changes. FY 1987 RDT&E decrease of $32,305 thousand was due to Congressional reductions. FY 1988 decrease of $2,311 thousand for RDT&E was due to adjustment of funds for restructuring the Ground Wave Emergency Network (GWEN) and addition of funds to Diversity Reception Equipment (DRE) program. FY 1988 Aircraft Procurement reduction of $86,500 thousand was due to deletion of aircraft modification funding. FY 1986 and FY 1988 Missile Procurement reductions of $8,500 thousand and $10,300 thousand respectively and increase of $47,074 thousand Other Procurement was the result of a major restructuring of the GWEN program. FY 1987 Other Procurement decrease of $84,893 thousand was due to congressional reductions and other programmatic changes.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands) *These funds are for many various types of Minimum Essential Emergency Comm Network (MEECN) communications equipment within projects and therefore no quantities are indicated.

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Aircraft Procurement:*						
TOTAL	800	0	0	40,116	Continuing	N/A
PE 33131F MEECN						
Project 2832	800	0	0	29,016	Continuing	N/A
PE 11312F Post Attack Command and Control System						
Project 2832	0	0	0	0	Continuing	N/A
Project 2834	0	0	0	11,100	Continuing	N/A
PE 32015F National Emergency Airborne Command Post						
Project 2834	0	0	0	0	Continuing	N/A
Missile Procurement:*						
PE 11213F Minuteman Squadrons						
Project 2834	0	0	0	13,428	Continuing	N/A
Other Procurement:*						
PE 33131F MEECN						
Project 2834	19,136	38,515	63,218	46,428	Continuing	N/A

Program Element: 33131F — Title: Minimum Essential Emergency Comm Network (MEECN)
DOD Mission Area: 331 - Strategic Command and Control — Budget Activity: 3 - Strategic Programs

5. (U) RELATED ACTIVITIES: Modifications to ground and airborne systems resulting from improvements developed under this program are funded in several program elements. PE 11312F, Post Attack Command and Control System, contains funding for Very Low Frequency/Low Frequency (VLF/LF) transmitter modifications, VLF/LF receiver modifications, and Ground Wave Emergency Network (GWEN) terminals for the EC-135 airborne command posts. PE 32015F, National Emergency Airborne Command Post, contains funding for GWEN terminals for the E-4B aircraft. PE 11126F, B-1B Squadrons, contains funding for Miniature Receive Terminal retrofit modification. PE 11213F, Minuteman Squadrons, contains funding for GWEN terminal integration into the Minuteman launch control centers. The Solid State Power Amplifier/Dual Trailing Wire Antenna (SSPA/DTWA) is a joint development with the Navy as lead service for a new higher power VLF/LF SSPA and DTWA system for the EC-135 Airborne Command Post Aircraft and the Navy Take Charge and Move Out (TACAMO) aircraft. A Memorandum of Agreement is maintained at the Assistant Secretaries of the Air Force and Navy level.

6. (U) WORK PERFORMED BY: Air Force Systems Command's Electronic Systems Division, located at Hanscom AFB, MA, has managerial responsibility for the Research, Development, Test and Evaluation, with support from the Rome Air Development Center, Griffis AFB, NY, Air Force Logistics Command, Strategic Air Command, and other Air Force major commands. Primary contractors are Analytical Systems Engineering Corporation, Burlington, MA (system engineering support); H&H Aerospace, Bedford, MA; Mitre Corp., Bedford, MA (system engineering support); Spears Associates, Norwood, MA (horizontal polarized airborne receive antenna); Sonicraft, Incorporated, Chicago, IL (Diversity Reception Equipment); Rockwell International, Richardson, TX (Miniature Receive Terminal); R&D Associates, Marina Del Ray, CA (Ground Wave Emergency Network); RCA, Camden, NJ (Ground Wave Emergency Network); Logical Technical Services, Newark, New Jersey (Diversity Reception Equipment); Data Metrics, Chatsworth, CA (Miniature Receive Terminal Printer).

7. (U) PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2832, Very Low Frequency/Low Frequency (VLF/LF) Improvements

A. (U) Project Description: This project consists of improvements to our existing VLF/LF communications system to extend range, improve resistance to jamming and nuclear effects, and increase message accuracy at all ranges. The system consists of (1) airborne transmitters and receivers in EC-135 and E-4B airborne command post aircraft and (2) a transmitter and receiver at Silver Creek, NE. The system improvements are based upon validated requirements of the Strategic Air Command and the other Single Integrated Operational Plan Commanders-in-Chief system deficiencies as reported by the Defense Communications Agency, and priorities of the Joint Chiefs of Staff.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Installation for the horizontally polarized airborne receive antenna continued via an aircraft modification contract. The Diversity Reception Equipment (DRE) program, now known as the MEECN Transmit Processor (MTP) program, continued Full Scale Development (FSD) with the award of Phase II. This program will be limited to the transmitter modification only. The Solid State Power Amplifier/Dual Trailing Wire Antenna (SSPA/DTWA) development began. Development of the Miniature Receive Terminal (MRT) for bombers continued.

(2) (U) FY 1987 Program: The FSD of the MRT, restructured DRE (MTP) and the SSPA/DTWA programs will continue. The MRT will be flight tested on the B-1B and B-52H bombers with production beginning not later than FY 1989. The MTP program will continue with the fabrication of the engineering development models. The joint Navy/Air Force SSPA/DTWA FSD continues. Horizontal Polarized airborne receive antenna modifications will be completed.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The request includes funds to continue development of the upgrades to our current Suvivable Low Frequency Communication System (487L). SSPA/DTWA FSD will continue with fabrication and testing of the prototype units. This effort will provide Air Force with a 100 Kilowatt (KW) SSPA replacing the existing 20 KW system. MTP Program continues with fabrication and testing of the engineering development model. Cost estimates for MRT and SSPA/DTWA are based on independent cost estimates from Electronic Systems Division. Estimates are based on competitive procurement strategy. Cost estimating category is III, budgetary.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: MRT will begin production not later than FY 1989. The FSD of SSPA/DTWA will continue to include prototype testing. FSD of restructured DRE (MTP) will be completed during FY 1989. Cost estimating category is III, budgetary.

(5) (U) Program to Completion: This is a continuing program. MRT production delivery will commence in FY 1991. SSPA/DTWA will begin Air Force production in FY 1990 leading to first Air Force production delivery and installation in FY 1991. MRT program is expected to be completed during FY 94. SSPA/DTWA program is estimated to be complete during FY 93.

C. (U) Major Milestones:

Milestones	Dates
(1) (U) SSPA/DTWA	
- Contract Award	January 1987
- Delivery of engineering test models	December 1988
- Air Force production decision	December 1989

Milestones	Dates
(2) (U) Horizontal Polarized Airborne Receive Antenna	
- Development Contract Award	July 1980
- Production Contract Award	August 1982
- Full Operational Capability (FOC)	FY 1987
(3) (U) MEECN Transmit Processor	
- Phase I Full Scale Development Contract Award	June 1982
- Phase II Full Scale Development Contract Award	May 1986
- Combined Field Development Test and Evaluation	July 1988
(4) (U) Miniature Receive Terminal (MRT)	
- Validation Contract Award	January 1983
- Development Contract Award	June 1985
- Production Contract Award	*(FY 1988) NLT FY 1989
- FOC	FY 1994

* Date presented in FY 87 Descriptive Summary

(U) Explanation of Milestone change.

(4) (U) Production of Airborne MRT may be delayed.

9. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2834, Ground Wave Emergency Network

A. Project Description: This project defines, develops, tests, and deploys a proliferated ground wave communications system. This system provides U.S. strategic forces with the ability to maintain critical continental United States (CONUS) long-range command and control communications connectivity despite ionospheric disturbances caused by nuclear detonations. The network will handle low speed data messages (100 words per minute) for CONUS commanders, bomber and tanker forces, and missile launch control centers. The program is divided into three phases. Phase I is the Initial Connectivity Capability and is the concept validation phase. Phase II is the Thin Line Connectivity Capability and is the prototype network. In Phase III the network will be expanded into a Final Operational Capability. Survivability for this system is provided primarily by proliferated relay nodes, using unmanned, electromagnetic pulse (EMP) hardened, low-frequency, ground wave radio equipment. Strategic force commanders and units (equipped with EMP-hardened, secure radio equipment) interact with nearby relay nodes for participation in the overall network.

Program Element: 33131F Title: Minimum Essential Emergency Comm Network (MEECN
DOD Mission Area: 331 - Strategic Command and Control Budget Activity: 3 - Strategic Programs

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: The Initial Connectivity Capability (a nine relay station proof of concept network) continued demonstration of software protocols, user interfaces, and EMP hardening techniques. The Full Scale Development effort continued towards fabrication and deployment.

(2) (U) FY 1987 Program: Installation of the prototype Thin Line Connectivity Capability (TLCC) network will be completed. TLCC includes 56 relay nodes. The Air Force will conduct initial operational test and evaluation in late FY 1987 employing no less than 43 of these nodes. The development of the EC-135 and E-4B airborne command post aircraft terminal and the missile launch control center receive only (RO) terminal will continue and portable RO terminal development will begin. Following testing, the prototype TLCC network will become the initial operational capability. The Air Force will then exercise a production option on the development contract to begin the production and installation of relay stations toward final operational capability. In FY 1987 additional fixed RO terminals will also be procured.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Expansion of GWEN toward Final Operational Capability (FOC) will continue with the production of relay nodes. Development of the EC-135 airborne terminals and portable RO terminal will be completed and development of the missile terminals will continue.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Development of missile terminals continues. Production and deployment of relay nodes leading to FOC will continue. The portable RO terminals and EC-135 airborne terminals will begin production.

(5) (U) Program to Completion: This is a continuing program. Production and installation of relay nodes will continue through FY 1991. Development, integration, production and installation of various types of GWEN terminals continues into the mid-1990's.

C. (U) Major Milestones:

	Milestones	Dates
(1) (U)	Initial Connectivity Capability (ICC) Contract Award	June 1982
(2) (U)	ICC Test Complete	April 1984
(3) (U)	TLCC	
	Design Contract Award	February 1983
(4) (U)	TLCC Fabrication/Deployment Contract Award	October 1983
(5) (U)	TLCC Development Completed	*(FY 1986) FY 1987
(6) (U)	Initial Operational Capability (IOC)	*(FY 1986) FY 1987
(7) (U)	Final Operational Capability (FOC)	*(FY 1992) FY 1996

* Date presented in FY 1987 Descriptive Summary

(U) Explanation of Milestone Changes:

(5) (U) Thin Line Connectivity Capability development of the relay node equipment has slipped because of software problems and site acquisition delays.

(6) (U) Initial Operational Capability (IOC) has slipped since deployment of the relay nodes has slipped delaying Initial Operational Test and Evaluation.

(7) (U) Above milestone changes combined with FY 1987 congressional cuts caused Final Operational Capability slip.

10. (U) COOPERATIVE AGREEMENTS: Not applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 33152F
DOD Mission Area: 391 - Strategic Information Systems

Title: USAF WWMCCS Information System (AFWIS)
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	4,338	7,592	5,107	5,319	Continuing	N/A
3155	USAF WWMCCS Information System	4,338	7,592	5,107	5,319	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The existing Worldwide Military Command and Control System (WWMCCS) does not permit the various military commanders to support the National Command Authorities in a timely, accurate, or cost-effective manner. Inadequacies of the current system preclude the development of highly interactive, user-friendly, on line query and retrieval capabilities that are deemed requisite to support of command and control requirements. The WIS is the modernization program for the information collection, processing, and display system includes WWMCCS Standard Automated Data Processing and related software systems, procedures, and supporting intr telecommunications. The Air Force WIS (AFWIS) program implements the Joint WIS program at Air Force WWMCCS sites modernizes AF unique Command and Control Systems.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	4,873	8,510	9,591	N/A	Continuing	N/A
Other Procurement	16,349	27,716	40,089	N/A	Continuing	N/A

Explanation: (U) The other procurement in FY 1987 was reduced due to Congressional action. The FY 1988 RDT&E and other procurement were reduced due to Department of Defense fiscal constraints and the revised acquisition schedule.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
Other Procurement: Funds	15,747	8,100	25,719	34,810	Continuing	N/A

Program Element: 33152F
DOD Mission Area: 391 - Strategic Information Systems

Title: USAF WWMCCS Information System (AFWIS)
Budget Activity: 3 - Strategic Programs

5. (U) RELATED ACTIVITIES: RDT&E for joint hardware and software is being performed by the Joint Program Manager and funded under PE 33154F, Worldwide Military Command and Control System (WWMCCS) Information System (WIS) Joint Program Management Office.

6. (U) WORK PERFORMED BY: Air Force Systems Command, Electronic Systems Division, Hanscom AFB, MA. The Engineering and Integration contractor is GTE Systems, Billerica, Massachusetts.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3155, USAF WWMCCS Information System (WIS)

A. (U) Project Description: Air Force WIS (AFWIS) directs the modernization, integration, and implementation of AF Standard (multi-command) and command-unique command and control application systems at Air Force sites.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: An AFWIS baseline was prepared by the System Program Office (SPO) and is in the final review phase. An engineering integration contract was awarded to plan for site unique systems. A majority of Air Force WWMCCS sites were visited in order to begin developing system architectures for each site.

(2) (U) FY 1987 Program: The integration contractor will continue major site planning (integration and installation) activities. Installation of Joint WIS Block A hardware will be completed at the Operational Test and Evaluation (OT&E) site, software development facility for the Air Force standard command and control software at Gunter Air Force Station, AL, and the Joint WIS Single Service Training Manager facility at Keesler Technical Training Center. Interface devices to interface the Air Force standard command and control system to the Joint Mission system will be designed, prototyped, installed and tested at the OT&E site with all the appropriate documentation.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Additionally four operational sites at US Readiness Command, Central Command, US Air Force Europe and Pacific Air Force will be installed. Interface devices for both hardware and software will be installed at all eight operational sites. Definition of command and control at units below major command level will be developed. Air Force Block B requirements will be identified and pre-installation tasks for Joint WIS Block B will be started. The cost estimates were updated by the AFWIS/SPO on 1 February 1985.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Complete installation of WIS Block A hardware at the remaining Air Force operational sites. Block B installation of Joint WIS equipment will begin at Tactical Air Command and Readiness Command in FY 1989, and pre-installation tasks for Joint WIS Block B equipment will be started at other Air Force sites.

(5) (U) Program to Completion: This is a continuing program. Systems engineering will be completed and interface units will be installed at sites. Software modernization will continue and Joint Mission and Air Force standard hardware installation will be completed at the remaining sites.

C. (U) Major Milestones:

	Milestones		Dates
(1) (U)	Air Force Worldwide Military Command and Control System (WWMCCS) Information System (AFWIS) Program Management Directive		August 1984
(2) (U)	Draft Air Force WIS (AFWIS) Baseline		December 1985
(3) (U)	Engineering & Integration Contract Award		March 1986
(4) (U)	AFWIS First Site (Implementation of WIS Block A at AF lead site)	* (January 1987)	June 1987
(5) (U)	AFWIS Sites 2 thru 21 Begins	* (May 1987)	November 1987

* Date presented in FY 1987 Descriptive Summary

(U) Explanation Of Milestone Changes

(4) (U) Block A installation for AF lead site is delayed due to the delay in contract award of Joint WIS integration contract.

(5) (U) Implementation at AFWIS sites 2 through 21 were delayed to accommodate the revised schedule for Operational Test and Evaluation sites.

8. (U) PROJECTS OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 33154F
DOD Mission Area: 391 - Strategic Information Systems

Title: WWMCCS Information System (WIS) Joint Program Management Office (JPMO)
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		56,422	94,930	82,089	91,425	312,951	700,258

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The WIS program was directed by the Deputy Secretary of Defense to modernize the data collection and processing (automatic data processing (ADP)) element of the Worldwide Military Command and Control System (WWMCCS) to provide command and control (C^2) information for the national command authorities (NCA); support strategic and conventional planning and command of forces; provide an effective crisis action management system; support execution planning and monitoring; and provide supportability and sustainability of information for command and support of forces. The existing WWMCCS ADP initially acquired in the early 1970s, upgraded through a single vendor and utilizing outdated software, is inadequate to support WWMCCS user needs. Reliance on a single vendor and older technology drives excessive maintenance costs. WIS will provide significantly improved C^2 support for use by the NCA; the Joint Chiefs of Staff (JCS); unified, specified, and component commands; and other C^2 organizations throughout the Department of Defense. WIS modernizes the WWMCCS Standard ADP software, hardware, and directly related telecommunications taking advantage of a modern software development and maintenance environment and state-of-the-art, commercial hardware and software to reduce life cycle costs. Key elements are modernization of the current WWMCCS software, development of automated message handling capability, and implementation of the Joint Operations Planning and Execution System and National Military Command System Information System required operational capabilities as approved by the JCS. The use of the Ada computer programming language is key to reduced life cycle software development and maintenance resource requirements.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	62,097	111,374	85,633	N/A	143,491	448,528

EXPLANATION: (U) Reduction in FY 1986 RDT&E reflects Gramm-Rudman-Hollings cuts and undistributed congressional cuts. Reduction in FY 1987 RDT&E reflects congressional action. Reduction in FY 1988 RDT&E reflects lower projections for inflation and slows development of Blocks B and C due to fiscal constraints of the Department of Defense budget. Increase in total estimated cost reflects consolidation of Army, Navy, and Air Force WIS joint RDT&E funding in PE 33154F and cost to replace funding deleted in prior years.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: PE 33151F (Worldwide Military Command and Control System (WWMCCS) Automatic Data Processing (ADP)) funds the current WWMCCS ADP systems. PE 33152F (WIS) funds Joint WIS procurement and Air Force standard software modernization which is closely coordinated with the WIS Joint Program Manager (JPM) effort. PEs 33152A/N (WIS) fund Joint WIS procurement and unique Army and Navy modernization programs which are closely coordinated with the WIS JPM effort. Portions of 33152A/N RDT&E resources, which partially funded the joint WIS effort from FY 1984 to FY 1987, were consolidated in 33154F beginning in FY 1988. PEs 33152K (WIS), 33151H (WWMCCS ADP), and 92498M (Management Headquarters (Admin)) fund Joint WIS procurement for Defense Communications Agency (DCA), Defense Nuclear Agency, and the Marine Corps, respectively.

6. (U) WORK PERFORMED BY: The WIS JPM is responsible for overall program management. Air Force Systems Command, Electronic Systems Division, Hanscom AFB, MA, is responsible for the engineering, development and acquisition of joint WIS. The primary contractors in FY 1987 are GTE, Billerica, MA; IBM, Gaithersburg, MD; MITRE, McLean, VA/Bedford, MA; and RMS Technologies, Trevose, PA. Other contractor efforts in FY 1987 total $3.6 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 33154F, WWMCCS Information System Joint Program Management Office

A. (U) Project Description: WIS is an evolutionary program which is modernizing the automated support for planning and execution of U.S. military operations. The program includes the transition from the old planning and support environment (WWMCCS Standard ADP), stressing modernization of software first, by utilizing the Ada computer programming language and modern data management tools. The government will manage and integrate the work of three primary contractors, and a system support contractor. Capabilities will be tested, procured and deployed incrementally to preclude interruption to the command and control mission. The program is divided into three increments or blocks. The first increment, Block A, provides a much needed automated message handling facility and a powerful desk-top workstation which multiply the effectiveness and timeliness of the operational staffs. It also puts in place the basic architecture for replacement of the current, outmoded system. The next block fields the initial joint mission applications software and modernized hardware. This is the critical phase that provides for the replacement of the existing system with improved automated support for joint planning and execution. It focuses on providing joint mission applications software to support deployment of military forces and execution of military operations under time-urgent conditions. The third increment of WIS will bring significant new capabilities to the commanders-in-chief and Joint Staff for strategy determination, development of suitable military options, and identification/evaluation of courses of action to carry out military options. New and improved joint mission software capabilities to support mobilization, sustainment and employment are essential elements of this block.

B. (U) Program Accomplishments and Future Efforts:

Program Element: 33154F
DOD Mission Area: 391 - Strategic Information Systems

Title: WWMCCS Information System (WIS) Joint Program Management Office (JPMO)
Budget Activity: 3 - Strategic Programs

(1) (U) FY 1986 Accomplishments: GTE continued full scale development of the local area network (LAN). The LAN preliminary design review was completed. LAN components were acquired for the Defense Communications Agency (DCA) operational support facility. Joint mission application software initial prototyping design began. A commercial database management system was selected to be used in application software prototype efforts. Development of the Software Development and Maintenance Environment (SDME) continued. IBM continued the initial automated message handling (AMH) software development and AMH development testing. Several critical design reviews for AMH components were completed. RMS Technologies continued independent verification and validation of WIS software. Development of A-level specifications and a draft request for proposal of the joint mission processing environment were begun. Detailed definition of Block B was initiated by GTE.

(2) (U) FY 1987 Program: GTE is scheduled to complete critical design review and development, and begin development testing of the LAN hardware and software. System critical design review is to be completed. Development testing of the initial release of AMH is also scheduled to begin. Installation of equipment to support operational test and evaluation (OT&E) of the first block of WIS capability is to begin at Forces Command and the Defense Communications Agency operational test sites. Prototype efforts for a standard data interface and supporting software will begin as well as the definition of a controlled mode security architecture for the WIS. Preparations for the request for proposal for the joint mission processing environment contract will continue. Prototyping of joint mission software will continue.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Installation of equipment to support OT&E is scheduled to begin at Tactical Air Command and US Pacific Command test sites. System test and evaluation of Block A hardware and software will be conducted at the Development and Evaluation Facility and the Operational Support Facility. Limited Block A LAN capabilities will begin to be procured for other operational sites. Block B will pass from concept validation and demonstration to full scale development with a Joint Requirements and Management Board milestone II review. Specifications for the joint mission processing environment and definition of the controlled mode security architecture will be completed. The cost estimate used for Block A of WIS is a mature estimate (cost category II) updated in May 1985 and for Blocks B/C is a preliminary planning estimate (cost category IV). The last comprehensive review of the estimate for Blocks B/C was made in December 1985. Independent cost analysis will be completed as succeeding increments of WIS pass through Joint Requirements and Management Board milestone II decisions.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Operational test and evaluationof Block A hardware and software will be conducted at four sites (Tactical Air Command, Forces Command, US Pacific Command, and Defense Communications Agency). Block A LAN and AMH capabilities will be deployed to operational sites. Full scale development of joint mission applications software will continue. This software will be a major part of the second increment (Block B) of WIS capability. Initial definition of the follow-on software (Block C) to support mobilization, sustainment and employment missions will begin. Standard data interface and supporting software specifications will be completed and will enter development. LAN, AMH, and workstation upgrades, including improvements to implement controlled mode security, will enter development.

(5) (U) Program to Completion: The integration and common user contractors are to continue pre-planned

automated message handling (AMH) and local area network (LAN) development, and deployment of WIS Block A to operational sites. Development test and evaluation of WIS capabilities will continue at the Development and Evaluation Facility. These tests are to include the joint mission processor in a controlled mode environment while incorporating the upgrades to Block A capabilities. Block B capabilities will be deployed to operational sites after Operational test and evaluation (OT&E). Block C will complete its concept definition and enter full scale development with the completion of a Joint Requirements and Management Board (JRMB) milestone II review. Development work will include efforts on advanced teleconferencing, simulation and analysis tools, further development of automated message handling capabilities, and joint mission applications software. Development and fielding of software to support mobilization, sustainment and employment missions in Block C is planned. OT&E on the succeeding capabilities developed for WIS will be conducted at operational test sites prior to operational deployment. WIS modernization program is expected to continue into the mid-1990's.

C. (U) Major Milestones:

		Milestones		Dates
(1)	(U)	Joint Mission Element Need Statement Published		February 1982
(2)	(U)	Report to Congress on Modernization of WIS		July 1982
(3)	(U)	Joint Operation Planning and Execution System and Related Required Operational Capabilities (ROC) Received		July 1983
(4)	(U)	Automated Message Handling (AMH) Multi-command ROC Received		September 1983
(5)	(U)	Integration Contract Award		October 1983
(6)	(U)	Common User Contract Award		October 1984
(7)	(U)	System Support Contract Award		July 1985
(8)	(U)	Block A Defense Systems Acquisition Review Council I/II		July 1985
(9)	(U)	Block B JRMB Milestone II	*(3rd Quarter FY 1987)	2nd Quarter FY 1988
(10)	(U)	Joint Mission Processing Environment Contract Award **	*(3rd Quarter FY 1987)	3rd Quarter FY 1988
(11)	(U)	Begin Block A OT&E	*(1st Quarter FY 1988)	1st Quarter FY 1989
(12)	(U)	Begin Low Rate Deployment of Block A	*(1st Quarter FY 1988)	1st Quarter FY 1989
(13)	(U)	Deploy Block B	*(FY 1989)	FY 1989 - FY 1991
(14)	(U)	Deploy Block C	*(FY 1990)	TBD

*Date presented in FY 1987 Descriptive Summary
**Previously titled Joint Mission Hardware Contract Award

(U) Explanation of Milestone Changes

(9) (U) Block B JRMB II was moved to 2nd quarter of FY 1988 due to Deputy Secretary of Defense direction to delay development and acquisition to accomodate Department of Defense budget contraints.

(10) (U) Joint Mission Processing Environment Contract award date was rescheduled to follow change in Block B milestone II decision.

(11) (U) Block A Operational Test & Evaluation was deferred to 1st quarter FY 1989 due to full scale development contracting delays in FY 1986, a design change in security architecture, and to provide additional interoperability testing with the current system.

(12) (U) Block A deployment was deferred to 1st quarter FY 1989 due to full scale development contracting delays in FY 1986, a design change in security architecture, and to provide additional interoperability testing with the current system.

(13) (U) Block B deployment is being revised to support incremental deployment of descrete Block B capabilities prior to full Block B deployment in FY 1991 due to prior year funding reductions and to accommodate Department of Defense budget constraints.

(14) (U) Block C deployment milestone planning is being revised due to prior year funding reductions and to accommodate Department of Defense budget constraints.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

Budget Activity: 3, Strategic Programs
Program Element: 33154F, WWMCCS Information System (WIS) Joint Program Management Office

Test and Evaluation Data

1. (U) Development Test and Evaluation (DT&E): DT&E on the Worldwide Military Command and Control System (WWMCCS) Information System (WIS) will be conducted according to the Test and Evaluation Master Plan (TEMP) which was approved by the Office of the Secretary of Defense after a Defense Systems Acquisition Review Council milestone I/II review of Block A in July 1985. An updated TEMP is expected to be approved in January 1987. The TEMP provides a description of the DT&E for each of the WIS elements. The WIS Test Planning Working Group (TPWG) will develop a Baseline Correlation Matrix in 1987. The matrix will provide traceability of user requirements through the operational test and evaluation program.

(U) The WIS is an evolutionary program. As each of its elements is developed, it will pass through component/subsystem DT&E, system DT&E, Integrated Systems Test, and operational test and evaluation. As each element passes through the latter stages of testing, as well as during its deployment, user feedback will be documented and, together with new user-defined requirements and new technology, will be used to plan and develop major enhancements. The enhanced elements will then pass through the same phases of testing. This iterative process will continue for the life of WIS and make its T&E an ongoing process.

(U) WIS is being implemented in a block approach which permits the system evolution to be divided into manageable portions. The elements of Block A which require developmental effort are the local area network (LAN) and the automated message handling (AMH) capability. The LAN DT&E will be conducted from January 1987 to November 1987. The AMH will undergo DT&E from October 1986 to August 1987. The first phase of Block A system DT&E will be completed in March 1988. No DT&E reports have been issued.

(U) An Integrated Systems Test (IST) at the Defense Communications Agency's (DCA) Operational Support Facility starts at the completion of the first phase of system DT&E and ensures that changes to the current WWMCCS automatic data processing operating system software and the WIS Block A capabilities are properly integrated. This testing will be planned and conducted by DCA. The IST will be performed from April 1988 to October 1988.

(U) The second phase of DT&E will be an operationally oriented system test utilizing user personnel in an actual operational environment. The purpose of the second phase is to ensure OT&E readiness. This test will be conducted at the Development and Evaluation Facility at Electronic Systems Division and at the actual operational test sites from June 1988 to October 1988.

(U) The WIS Joint Program Manager directs the Joint WIS program and tasks engineering development and acquisition activities to the WIS System Program Office (SPO). The Director, WIS SPO, Electronic Systems Division, chairs the TPWG and is responsible for the management of all DT&E activities. DT&E will be conducted at the Development and Evaluation Facility with the assistance of the WIS Integration Contractor and associate contractors, which are developing portions of the system. The facility was developed and is operated by the WIS SPO. The Integration contract was awarded to GTE, the Common User contract was awarded to IBM, and a Systems Support contract was awarded to RMS Technologies. Additional contracts for hardware and software will be awarded later in the program.

Budget Activity: 3, Strategic Programs
Program Element: 33154F, WWMCCS Information System (WIS) Joint Program Management Office

2. (U) Operational Test and Evaluation (OT&E): There has been no OT&E conducted on WIS and no OT&E reports have been issued. OT&E is scheduled for October 1988 to November 1988. OT&E will be conducted at the Operational Support Facility (OSF) in Reston, Virginia, and at operational test sites for Headquarters Tactical Air Command, Headquarters Forces Command, and Headquarters US Pacific Command. The OT&E will consist of exercises conducted by the four sites, with the OSF configured as the National Military Command Center. Functional users from the test sites and scenarios based on Organization of the Joint Chiefs of Staff (OJCS) exercises will be used to ensure a realistic test environment. Operational testing will satisfy the operational critical issues of mission utility, responsiveness, flexibility, survivability, interoperability, security, availability, and software supportability.

(U) Responsible OT&E agencies. Headquarters Air Force Operational Test and Evaluation Center is the lead OT&E agency for WIS. Supporting OT&E agencies are the Commander Operational Test and Evaluation Force (Navy) and the Operational Test and Evaluation Agency (Army). The Director for Command, Control and Communications Systems represents the OJCS in OT&E planning.

3. (U) System Characteristics: The WIS key operational and technical performance requirements are based upon the Joint Chiefs of Staff approved Joint Operation Planning and Execution System, the National Military Command System Information System, and Automated Message Handling Multi-command Required Operational Capabilities (ROCs). These ROCs were analyzed and yielded the following WIS Block A objectives and thresholds (approved at the July 1985 Defense Systems Acquisition Review Council):

Characteristic	Objective/Threshold	Demonstrated
Response Time		
Simple (priority)	8 - 10 Seconds	No tests conducted
Complex (priority)	2 - 4 Minutes	
Security	System High (Highest Level of Classification)	
Usability	20 Hours Training	
Interoperability	Automatic Digital Network (AUTODIN), Defense Data Network (DDN)	
Availability	95%	
Crisis	98%	
Mean Time Between Failure (Workstation/ Printer)	1500 Hours	
Diagnostics (Automated Message Handling Processor)	90% Fault Detection Rate	

Budget Activity: 3, Strategic Programs
Program Element: 33154F, WWMCCS Information System (WIS) Joint Program Management Office

Characteristic	Objective/Threshold	Demonstrated
Software Portability	Multiple Workstation Use	No tests conducted
Hardware Portability	Multiple Vendor Work-stations Accessible on the Local Area Network	
Peak Messages Received per Day	2000	
Peak Messages Received per Hour	300	
Peak Messages Transmitted per Hour	100	

NOTE: Blocks B and C of WIS will add capabilities and will be defined in detail as the program progresses.

4. (U) Current Test and Evaluation: No operational test and evaluation (OT&E) has been done in the WIS Program for the past twelve months. No OT&E is planned for the next twelve months.

T&E Activity (Past 12 Months)

Event	Planned Activity	Actual Date	Remarks
Automated Message Handling DT&E	June 1986- June 1987	October 1986- August 1987	In progress. DT&E start was delayed due to design changes in security architecture.

T&E Activity (Next 12 Months)

Event	Planned Date	Remarks
Local Area Network DT&E	January 1987- November 1987	DT&E start was delayed due to full scale development contracting delays.
Automated Message Handling	January 1987- August 1987	Continued from 1986.
Block A System DT&E (Phase I)	October 1987- March 1988	

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 33601F Title: Milstar Satellite Communications System (AF Terminals)
DoD Mission Area: 333 - Strategic Communications Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		117,234	271,968	229,229	310,353	Continuing	N/A
2487	Milstar(AF Terminals)	117,234	271,968	229,229	310,353	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program develops and acquires Air Force Satellite Communications (AFSATCOM) Ultra High Frequency terminal modifications, transponder test set upgrades, and gap filler AFSATCOM payloads, required for transition to the Milstar satellite system. It also provides resources for development/ acquisition of Milstar Extremely High Frequency terminals for the Air Force. The Milstar satellite system will provide a highly survivable, jam-resistant, worldwide, secure communications system to support the President and the military Commanders-in-Chief for command and control of selected United States strategic and tactical forces in all levels of conflict.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	124,254	298,527	291,272	N/A	Continuing	N/A
Aircraft Procurement	0	0	0	N/A	Continuing	N/A
Missile Procurement	32,584	0	0	N/A	Continuing	N/A
Other Procurement	0	55,370	0	N/A	Continuing	N/A

EXPLANATION: (U)

(U) RDT&E: FY 1986 and FY 1987 reductions due to Congressional actions. FY 1988 - $62,043 decrease is sum of a $24,000 increase to fund the development of mobile/transportable Low Volume Terminals, a Zero Balance Transfer (ZBT) of $-45,701 to accelerate aircraft terminal procurement for the E-4B (Program Element 32015F), a $3,880 reduction in Launch Control Center hard antenna development no longer required in near term, a $23,000 decrease to delay general Missile Weapon System terminal design, a $-7,400 ZBT to Aircraft Procurement appropriation to fund needed time synchronization units for AFSATCOM terminals and $-6,062 in profit/inflation adjustments.

(U) Aircraft Procurement: FY 1988 - $2,900 increase is the sum of a $7,400 ZBT from RDT&E above to fund Hand Held Module and Time Distribution Subsystems and a $4,500 decrease to balance budgets among high priority programs.

(U) Other Procurement: FY 1987 reductions due to Congressional action.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Aircraft Procurement						
Funds	0	0	2,900	21,673	1,943,300	1,967,873
Quantities	0	0	(420 timing units)		419 terminals	419
Missile Procurement						
Funds	30,782	0	0	0	Continuing	N/A
Quantities	1	0	0	0	1	N/A
Other Procurement						
Funds	0	725	0	59,681	1,218,409	1,278,090
Quantities (terminals)	0(Spares for ground timing units)			5	296	301
Military Construction						
Funds	0	0	0	5,300	202,931	208,231

5. (U) RELATED ACTIVITIES: Missile Procurement funding in FY 1991 and following procures additional Ultra High Frequency (UHF) transponders on classified host spacecraft to maintain the current Air Force Satellite Communications (AFSATCOM) UHF capability. Procurement and installation of transition upgrades to airborne AFSATCOM terminals to allow UHF compatibility with the Milstar system are funded within the modification line of each weapon system Program Element (PE). Approved transition users include the following PE's: PE 11113F, B-52 Squadrons; PE 11115F, FB-111 Squadrons; PE 11126F, B-1B; PE 11213F, Minuteman Squadrons; PE 11312F, Post Attack Command and Control System/World Wide Airborne Command Post (EC-135); PE 27222F, KC-10A; PE 28019F, Tactical Cryptologic Activities (RC-135); and PE 32015F, National Emergency Airborne Command Post/E-4B Class V Mode. PE 33603F, Milstar Satellite Communications System (Space and Mission Control), will develop and acquire the spacecraft and mission control segments for this highly survivable, jam-resistant, worldwide command and control communications system.

6. (U) WORK PERFORMED BY: Selected terminal modifications for transition of the AFSATCOM system to Milstar are being developed and produced by Rockwell International, Santa Ana, CA, and Linkabit Corp, La Jolla, CA. Remaining AFSATCOM terminal modifications and the Air Force Milstar EHF terminals are being developed by the Raytheon Company, Sudbury, MA., teamed with Rockwell Collins of Cedar Rapids, IA. and Bell Aeospace of Buffalo, NY. Federal Contract Research Center support is provided by the MITRE Corporation, Bedford, MA, and Lincoln Laboratory, Lexington, MA.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

Program Element: 33601F Title: Milstar Satellite Communications System (AF Terminals)
DoD Mission Area 333 - Strategic Communications Budget Activity: 3 - Strategic Programs

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: #2487, Milstar Satellite Communications System (AF Terminals)

A. (U) Project Description: The upgrade of Air Force Satellite Communications (AFSATCOM) to Milstar involves both command post and force element terminals and is being executed in multiple steps to maintain strategic connectivity during the transition. Command post terminals in EC-135 aircraft and at selected ground locations will be upgraded to the Milstar Ultra High Frequency (UHF) modulation compatibility in FY 1989-FY 1990 to allow immediate use of the on-orbit Single Channel Transponders and early use of Milstar satellites. In FY 1991 and following, these same terminals plus mobile command posts and satellite mission control elements will be upgraded to full Extremely High Frequency (EHF)/UHF capability. Nine EC-135C command post aircraft are planned to receive early EHF/UHF Engineering Development Model allowing an early EHF injection capability (EHF uplink, UHF downlink) into the first Milstar satellites. The remaining command posts (EC-135H/J/P, E-4B, E-6) will receive full capability starting in FY 1992. Force element terminals will receive the UHF Dual Modem Upgrade starting in FY 1987 and it is expected that at least 450 force element aircraft (B-52, B-1B, EC135A/G, RC135, etc.) will have Milstar UHF capability prior to launch of the first satellite. Finally, force elements will be upgraded to EHF by the mid 1990's providing full jam and scintillation resistant communications capability.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Installation of AFSATCOM UHF terminal dual modem and receiver modifications for compatibility with Milstar began. The Milstar UHF command post transition terminal modifications were fabricated, assembled and extensive in-plant testing was initiated. Full Scale Development (FSD), Phase II of the EHF and EHF/UHF terminals continued. Fabrication of initial EHF terminal hardware was completed and integration began. The Critical Design Review for the B-1B EHF terminal was completed and fabrication of the engineering model was initiated.

(2) (U) FY 1987 Program: Installation of Milstar upgrades to command post and force element AFSATCOM terminals will continue. Field Development Test and Evaluation of the UHF transition command post terminal will be completed. Long-lead will be procured for the transition terminal. Fabrication and integration of three qualification model EHF-EHF/UHF terminals will be completed and qualification and reliability tests will be performed. Setup will begin for in-plant developmental testing and evaluation of EHF terminals planned for December 1987 using the Fleet Satellite (FLTSAT) Communications System EHF transponder package successfully placed into orbit on FLTSAT 7 on 4 December 1986. The upgrade of AFSATCOM host vehicle transponder test equipment will begin. Additional high inclination AFSATCOM transponders will be required in the mid-1990's to maintain strategic connectivity if existing assets survive only to their predicted design life. The existing AFSATCOM transponder design must be upgraded to replace components no longer available. Upgrading the test equipment will allow design and test of a new UHF transponder for host satellites and provide an enhanced capability for testing transponders already on orbit. [illegible] definition and architecture for a Low Volume EHF Terminal (LVT) will be completed. The LVT design goal [illegible] 300 pounds as compared with 800 pounds for the standard Milstar EHF terminal. The goal for ground

Low Volume Terminals (LVT's) is 200 pounds with a very limited capability 50 pound terminal possible. These miniaturized terminals will meet requirements for National Command Authority, advanced aircraft, special forces, and classified survivable communications.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Funding of development of the upgraded Air Force Satellite Communications (AFSATCOM) transponder by the host program office will begin. Major technology insertion development for the LVT will begin. The installation of force element and command post Ultra High Frequency (UHF) radio upgrades to permit fast frequency hopping will begin. The installation of UHF upgrades in force element aircraft and ground terminals as well as production of UHF transition terminals for command posts will continue. Prototype standard terminals will be tested against EHF transponders aboard Navy Fleet Satellites to support a Low Rate Initial Production (LRIP) decision. Most RDT&E funds will be applied to the fabrication and deployment of Engineering Development Model (EDM) terminals for EC-135C aircraft and selected ground sites. These EDM terminals will provide an early capability for very jam resistant cross band operation (Extremely High Frequency (EHF) uplink and UHF downlink) with force element terminals. Additional RDT&E will be applied to fabrication and assembly of conformal antennas for Presidential requirements as well as aircraft and missile systems currently in the design phase. An in-depth evaluation of over 3000 Work Breakdown Structure elements was made using costing analogies, parametric models, contractor estimates, catalog prices, cost estimating relationships and engineering assessments. An Independent Cost Assessment for the core standard terminal program was performed and the results presented to the Office of the Secretary of Defense Cost Analysis Improvement Group on 1 February 1985. A firm price from the Phase II Full Scale Development (FSD) contractor has been included in the current cost estimate. The cost estimates for the LVT and AFSATCOM transponder development programs are currently Category III, Budgetary. The cost estimate for the core standard terminal program is Category I, Comprehensive.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Funding of AFSATCOM transponder development will continue. Detailed design of the LVT will begin. Development of special antennas for advanced aircraft and non-standard ground applications will continue. The installation of force element and command post UHF upgrades will continue. The Initial Operating Capability for the improved AFSATCOM UHF Single Channel Transponder Injection System will be reached. Production and installation of EDM EHF terminals will continue. LRIP of EHF terminals will begin for planned installation beginning in FY 1991. The cost estimates for the LVT and AFSATCOM transponder development programs are currently Category III, Budgetary. The cost estimate for the standard EHF and EHF/UHF terminal development program is Category I, Comprehensive.

(5) (U) Program to Completion: This is a continuing program. Successful testing of LRIP sets against the first on-orbit Milstar satellite will initiate full production, which will continue at least through the mid-nineties.

C. (U) Major Milestones:

Milestones	Dates
(1) (U) Milstar Terminal Full Scale Development (FSD) Start	September 1983
(2) (U) Extremely High Frequency (EHF) Preliminary Design Review	June 1984
(3) (U) EHF Terminal Critical Design Review	February 1985
(4) (U) Phase II FSD Contract Award	May 1985
(5) (U) Start of EHF Terminal Qualification Model Integration	August 1986
(6) (U) Ultra High Frequency Transition Contract	July 1987
(7) (U) Milstar Low Rate Initial Production Start	FY 1989

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

Budget Activity: 3, Strategic Programs
Program Element: 33601F, Milstar Satellite Communications System (Air Force Terminals)

Test and Evaluation Data

1. (U) Development Test and Evaluation (DT&E):

(U) Test Schedule

(U) Air Force Satellite Communications System (AFSATCOM) Upgrade Testing	FY86/87
(U) In-plant DT&E:	FY86/88
- Brassboard/Prototype Testing	FY86/87
- On Orbit Fleet Satellite (FLTSAT) Transponder Tests	FY88
- Reliability/Growth Tests	FY89

Field DT&E/Initial Operational Test & Evaluation (IOT&E) [ ]

(U) AFSATCOM Terminal Dual Modem/ARC-171 Upgrade - To prevent loss of communications during transition between the existing AFSATCOM Ultra High Frequency (UHF) communications system and the new Milstar Extremely High Frequency (EHF) system, existing AFSATCOM terminals are being upgraded to be compatible with the limited UHF capability on the Milstar satellite and jam resistant modes on Single Channel Transponders now present on a variety of host spacecraft. The modifications involve replacement of several circuit boards in existing AFSATCOM modulator-demodulator (MODEM) units and minor ARC-171 radio modifications. Downward compatibility to AFSATCOM is maintained. Most developmental testing of the Dual Modem and ARC-171 radio modifications has been completed and there are no significant discrepancies.

(U) Milstar Terminals - The Air Force awarded a contract for the second phase (post Critical Design Review) of terminal Full Scale Development to the Raytheon Company, Sudbury, Massachusetts in May 1985. Major subcontractors include the Rockwell International, Advanced Communication & Countermeasures Division of Santa Anna, California and Bell Aerospace Textron of Buffalo, New York. The Air Force Milstar Terminal Program Office at Electronic Systems Division has formed a Terminal Test Planning Working Group to coordinate test issues. Detailed test plans arrived to support the February 1985 Critical Design Review. In-plant developmental testing will be accomplished with the Milstar Design Verification Model and satellite test sets. Field level developmental testing will begin first with the launch of the FLTSAT Extremely High Frequency packages and later with the Milstar satellites. Development testing will transition to initial operational testing after checkout of the engineering development model terminals.

2. (U) Operational Test and Evaluation (OT&E): (See also Program Element 33603F Milstar Satellite Communications Program.)

Budget Activity: 3, Strategic Programs
Program Element: 33601F, Milstar Satellite Communications System (Air Force Terminals)

(U) The Milstar Air Force Terminal Initial Operational Test and Evaluation (IOT&E), being managed by the Air Force Operational Test and Evaluation Center (AFOTEC), will consist of an operational assessment to support a Low Rate Initial Production (LRIP). Additional IOT&E will be included in the Milstar multiservice IOT&E (program element 33603F).

(U) The LRIP assessment will be based on in-plant Development Test & Evaluation (DT&E) testing, review of DT&E test results, and some limited Operational Test & Evaluation (OT&E) analysis. The assessment will estimate the Milstar terminal operational effectiveness and suitability as test assets become available (such as engineering development models, Fleet Satellite Communications (FLTSATCOM) Extremely High Frequency Package, and Developmental Verification Models). Preliminary interoperability with Navy and Army terminals will also be evaluated. In addition to considerable ground testing, a total of 800 hours of DT&E/IOT&E flight testing has been projected in EC-135 and B-52 aircraft. This assessment will conclude in 1990.

Under the multiservice IOT&E, Milstar will be evaluated during simulated and actual operation with Milstar satellites in realistic test scenarios. The multiservice IOT&E test team will form in late to initiate training and program familiarization. Testing will be conducted with at least two satellites to evaluate cross-link connectivity.

(U) A limited IOT&E(1) program was conducted during the year prior to the February 1985 Critical Design Reviews (CDR) for the Milstar AF Terminal. In the November 1985 final report, AFOTEC listed five concerns which have since been resolved;

(1) (U) Software Security - AFOTEC reported that better software security procedures must be exercised by the contractors during software development and testing. The terminal program office, working with the Computer Resources Working Group, strengthened security procedures. Under the new program; terminal software is developed in a vaulted area, special separate software security monitor code is being developed in a separate area, extensive software reviews have been instituted, access to the software is strictly controlled, and the contractor has been trained and is fully supportive of software security procedures.

(2) (U) Logistics Support Analysis (LSA) - AFOTEC participants in the source selection determined that LSA was not being accomplished correctly. The program office has updated and verified the LSA "A" sheet to reflect more accurate estimates. The update is on revision "G" and is in an iterative update cycle.

(3) (U) Integrated Diagnostics - AFOTEC review of the logistics documents and attendance at Program Design Reviews, led to the finding that the original maintenance concept did not include the use of integrated diagnostics. This problem has been resolved and there is now a fully integrated approach with extensive Built-In-Test at the terminal level as well as Modular Automated Test Equipment (MATE) at the Intermediate and Depot Maintenance levels. Compatible software design within the terminal and MATE system will reduce non-reproduceable

(5) (U) Threat - AFOTEC reported that the threat to Milstar was not baselined into Milstar system specifications and that threat documentation did not address the total threat. A new, more detailed Milstar System Threat Assessment Report (STAR) is in process and currently in Defense Intelligence Agency coordination. The new assessment addresses the total system and will permit the specifications to be properly updated, if required.

3. System Characteristics:

Characteristic	Objective/Threshold	Demonstrated
EHF Max Data Rate (kilo-bits/sec)	2.4	To be demonstrated
Bit Error Rate (EHF fully processed)		To be demonstrated
Bit Error Rate (EHF partially processed)		To be demonstrated
Bit Error Rate (Ultra High Frequency)		To be demonstrated
Anti-Jam Protection, degradation in deci-bells of Energy-Per-Bit/Noise-Energy for specialized jamming (pulse, chirp, partial band tone, partial band noise.) at 10^{-5} decoded bit-error rate.		To be demonstrated
Terminal Mission Availability (12 hour mission)	.96	To be demonstrated

Budget Activity: 3, Strategic Programs
Program Element: 33601F, Milstar Satellite Communications System (Air Force Terminals)

4. (U) Current Test and Evaluation (T&E):

T&E Activity (Past 12 Months)

Event	Planned Activity	Actual/Predicted Date	Remarks
Dual Modem Upgrade Qual Part I	Dec 85	Apr 86	Delayed by alarm & synthesizer problems
Milstar Terminal-Payload Breadboard	Jan 86	Jan 86	Against Spacecraft Breadboard on ground
ARC-171H Physical Configuration Audits	Feb 86	May 86/Sep 86	Synthesizer Card/Control Monitor complete
Milstar Terminal Prototype Test	Oct 86	Nov 87	Restructured to be against develop model
Dual Modem Upgrade Qual Part II	Jan 87	Apr 86	Combined with Part I tests
Dual Modem Physical Configuration Audit	Feb 87	Apr 86	
Inital plans for LRIP Test Approach	Oct 86	Feb 87	In Test & Evaluation Master Plan
Finalize LRIP Test Plan	Jan 86	Mar 87	
Activate LRIP Assessment Team	Mar 86	Mar 87	Adjusted to reduce manpower requirements

T&E Activity (Next 12 Months)

Event	Planned Date	Remarks
Updated Test & Evaluation Master Plan	Feb 87	
Dual Modem Field Compatibility Test	Feb 87	Verify channel 1.5 in field
Milstar UHF to Payload Test (Ground)	Feb 87	Waveform compatibility test
Milstar UHF to On-Orbit AFSATCOM	Jun 87	AFSAT and Single Channel Transponder
Milstar EHF to Ground FEP Unit	Jun 87	At Lincoln Laboratory
EHF/UHF System Compatibility	Nov 87	
Milstar EHF to FLTSAT EHF Package	Dec 87	
Test Program Outline Revision	Feb 88	

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 33603F
DOD Mission Area: 333 - Strategic Communications

Title: Milstar Satellite Communications System (Space and Mission Control)
Budget Activity: 3 - Strategic Programs

1. RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		331,312	470,316			Continuing	N/A
2932	Milstar	331,312	470,316			Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Milstar Satellite Communications System program is a joint service program to develop and acquire the Milstar Extremely High Frequency (EHF) satellite, its mission control segment, and new or modified communications terminals. The Milstar system will provide a highly survivable, jam-resistant, world-wide, secure communications system to meet the minimum essential wartime communications needs of the President and Commanders-in-Chief to command and control selected Air Force strategic and tactical forces through all levels of conflict. It will also support other high priority users in crisis/contingency situations. This Program Element funds for development of the Milstar satellite and its associated Mission Control Elements (MCE).

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	336,886	493,357	439,438	N/A	Continuing	N/A

EXPLANATION: FY 1986 and FY 1987 - Reductions due to Congressional action. FY 1988 - Net reduction of resulted from a two year funding slip of Developmental Flight Satellites #4 and #5 (DFS-4) (DFS-5) and a proportional share of the consultant costs reduction.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: The Air Force has total system development responsibility, heads the Joint Milstar Program Office and manages the development and acquisition of the space and mission control segments. Each Service manages a terminal program (Air Force for airborne and selected ground, Navy for shipborne and selected ground, and Army for ground) under the orchestration of the Milstar Joint Terminal Program Office managed by the Navy (PE 33603N).

Program Element: 33603F
DOD Mission Area: 333 - Strategic Communications

Title: Milstar Satellite Communications System (Space and Mission Control)
Budget Activity: 3 - Strategic Programs

The Milstar program was initiated in FY 1982 with funds in the Space Communications program (PE 63431F) and Air Force Satellite Communications System (AFSATCOM) (PE 33601F). The Milstar Satellite Communications System (PE 33603F) was created in the FY 1983 President's Budget submission and contained both satellite and terminal development funds. However, beginning in FY 1984, Air Force Extremely High Frequency (EHF) terminal development is funded in Milstar Satellite Communications System (Air Force Terminals) (PE 33601F), formerly AFSATCOM, and the Milstar satellite and Mission Control Element (MCE) development is funded in Milstar Satellite Communications System (Space and Mission Control) (PE 33603F). This is consistent with all other DOD Satellite Communications (SATCOM) development and production programs. In addition to developing the new Milstar satellite, the Air Force is also managing the development and acquisition of the EHF applique packages for Fleet Satellite Communications vehicles F-7 and F-8 which are funded in the Navy's *EHF SATCOM (PE 64577N)*. The Army and Navy terminals are funded under Satellite Communications Ground Environment (PE 33142A) and EHF SATCOM (PE 64577N and 33109N) respectively. Air Force Ground Mobile Forces terminals are being funded under Satellite Communications Terminals (PE 33605F). Development of Titan IVs to provide assured access to space for Milstar is funded in Space Boosters (PE 35119F).

6. (U) WORK PERFORMED BY: The development of the Milstar satellite and the MCE for the Milstar system is managed by Air Force Systems Command's Space Division, Los Angeles AFS, CA. The contract for Full Scale Development of the Milstar satellite and MCE was awarded on 30 June 1983. The prime contractor is Lockheed Missiles & Space Co., Sunnyvale, CA. Subcontractors to Lockheed include: Hughes Aircraft Co., El Segundo, CA (crosslink and frequency and time standards subsystems); TRW, Inc., Redondo Beach, CA (payload subsystem); General Electric Co., Valley Forge, PA (data handling subsystem); and Ford Aerospace Communications Corporation, Palo Alto, CA (crosslink receivers). The Aerospace Corporation, El Segundo, CA, provides general system engineering and integration.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: #2932, Milstar Satellite Communications System (Space and Mission Control)

A. Project Description: This program designs, fabricates, tests, and acquires the Milstar EHF satellite consisting of the mainframe (or "bus"), the communications payload, antenna suite and the MCE. The system will incorporate state-of-the-art techniques for jam-resistance and survivability. Key features include higher frequencies, bandspreading, on-board signal processing, end-to-end encryption, hardening, a high degree of autonomy and on-orbit storage. A special endurance feature of Milstar is the MCE which will allow selected command terminals located on survivable platforms to control the satellite/system. An Ultra High Frequency (UHF) package will provide backward compatibility with existing UHF systems and facilitate the transition to EHF. This program will provide world-wide, two-way, jam-resistant, secure, highly survivable and enduring communications capability.

B. (U) Program Accomplishments and Future Efforts:

Program Element: 33603F
DOD Mission Area: 333 - Strategic Communications

Title: Milstar Satellite Communications System (Space and Mission Control)
Budget Activity: 3 - Strategic Programs

(1) (U) FY 1986 Accomplishments: The primary effort included continued, detailed design work and completion of the satellite and mission control segments Preliminary Design Reviews. Major emphasis was placed on detailed planning for payload testing and integration of the payload into the satellite bus. Some satellite subsystem Critical Design Reviews (CDR) were conducted. Fabrication of Developmental Flight Satellite #1 (DFS-1) continued, and options for the fabrication of DFS-2 and long lead for DFS-3 were exercised. The National Aeronautics and Space Administration termination of the Centaur Upper Stage program for Space Transportation System (STS) safety reasons resulted in the deletion of the requirement for satellite dual compatability between the Titan IV and the STS. As a result, the Milstar satellite will now be launched solely using Titan IVs and Centaur Upper Stages.

(2) (U) FY 1987 Program: The primary effort will be fabrication and testing of the DFS-1 and its communications payload. Long lead for DFS-3 will continue, and the fabrication option will be exercised. Long lead for DFS-4 will be exercised. Fabrication of DFS-1 and DFS-2 will continue. The system level CDR for the space segment and subsystem level CDRs for the mission control segment are planned. Major emphasis will be placed on integration of the satellite with the Centaur Upper Stage and then integration of the spacecraft and Centaur with the Titan IV. Development of system level end-to-end test plans will be completed and initial system level testing will begin. Preliminary planning for Initial Operational Test and Evaluation of the Mission Control Element (MCE) will start on both ground and airborne platforms.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The basic program includes completion of the final bus assembly for DFS-1, integration of the payload onto the spacecraft, continued fabrication of DFS-2 and DFS-3. The system level CDR will be conducted for the MCE. Platform design work will be conducted for future installation of engineering development model MCEs. Launch system integration of the Milstar spacecraft with the Titan IV will continue. Cost estimates are mature, Category II and based on current contract awards, an update to the Independent Cost Analysis for the satellite and MCE completed in November 1984, and a Single Best Estimate for the satellite and MCE completed in November 1986.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: DFS-1 hardware and software integration will continue. Bus and payload integration will be completed. Qualification testing and system level acceptance testing will continue. Fabrication of DFS-2 and DFS-3 will continue. Cost estimates are mature, Category II and based on current contract awards, an update to the Independent Cost Analysis for the satellite and MCE completed in November 1984, and a Single Best Estimate for the satellite and MCE completed in November 1986.

(5) Program to Completion: This is a continuing program. Development work will continue on the satellite and MCE with launch of DFS-1 scheduled for not later than [ ] (Developmental satellites two through five will be launched by [ ]) All satellites will be launched solely using Titan IVs and Centaur Upper Stages. Satellite production, commencing with satellite number six, is scheduled to begin in FY 1992. Installation of engineering development model MCEs will begin in FY 1990. Installation of production MCEs will begin in FY 1994.

Program Element: 33603F
DOD Mission Area: 333 - Strategic Communications

Title: Milstar Satellite Communications System (Space and Mission Control)
Budget Activity: 3 - Strategic Programs

C. Major Milestones:

Milestones		Dates
(1) (U) Program Start		April 1981
(2) (U) Start Concept Validation Phase		March 1982
(3) (U) Full Scale Development Contract		June 1983
(4) (U) Satellite Payload Preliminary Design Review (PDR)		July 1984
(5) (U) Satellite System PDR		November 1985
(6) (U) Start Fabrication of Developmental Flight Satellite #1 (DFS-1)	*(December 1985)	September 1986
(7) (U) Satellite System Critical Design Review (CDR)		FY 1987
(8) ( ) Delivery of satellite to launch facility		[ ]
(9) ( ) Launch of DFS-1		[ ]
(10) ( ) Launch of tenth Milstar satellite (Approximate Full Operational Capability)		[ ]

* Date presented in FY 1987 Descriptive Summary

(U) Explanation of Milestone Changes

(6 & 7) (U) Date of the start of fabrication of DFS-1 changed to reflect the program slip due to the Balanced Budget and Emergency Deficit Control Act of 1985 (Gramm-Rudman-Hollings).

(9) (U) Date of first launch was changed to reflect the program rephase, Gramm-Rudman-Hollings impact, and the 22 August 1986 Department of Defense decision to delay launch of first satellite up to one year.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

Budget Activity: 3, Strategic Programs
Program Element: 33603F, Milstar Satellite Communications System (Space and Mission Control)

Test and Evaluation Data

1. (U) Development Test and Evaluation (DT&E): The Full Scale Development contract for the Space and Mission Control Segments was awarded in FY 83 and DT&E has started.

(U) Test Schedule

( ) Satellite and Mission Control Element (MCE) Part/Circuit/Box Level Survivability Tests

( ) Interface Tests - Payload to Terminal
- MCE to Satellite
- MCE to Air Force Terminal

( ) System Level End-to-End Tests (Performance, Survivability, Interoperability)

( ) On-Orbit DT&E Tests

(U) In March-April 1986 the Navy contractors tested their Engineering Development Model (EDM) terminals with the Fleet Satellite Extremely High Frequency (EHF) package (FEP) flight model F-7. In October 1986, the Navy contractors tested their EDM terminals with the FEP flight model F-8. All ambiguities, incompatibilities, and areas of concern from the July-August 1985 tests with the FEP prototype were successfully retested to ensure resolution. No new ambiguities or incompatibilities were detected.

(U) Milstar is a joint service program with participation by all services. The Air Force has been designated Executive Agent for Milstar. The Joint Milstar Program Office provides overall management of the Milstar program and is located at Air Force Systems Command's Space Division in Los Angeles, CA. The Space and Mission Control Segments of the Milstar program are managed from Space Division. The Terminal Segment efforts are orchestrated by the Joint Terminal Program Office (JTPO) which is a part of the Navy's Space and Naval Warfare Systems Command in Washington, DC (Program Element [PE] 33603N). The JTPO provides guidance and system engineering support to each service terminal program office. The Air Force terminal program office is located at Air Force Systems Command's Electronic Systems Division, Hanscom AFB, MA. The Air Force terminal program is discussed in the Test and Evaluation Data Sheet for PE 33601F, Milstar Satellite Communications System (Air Force Terminals). The Navy terminal program office is located at Space and Naval Warfare Systems Command's Navy EHF Satellite Communications Terminal Program Office, Washington, DC. The Navy Milstar terminal effort is contained in PE 64577N and PE 33109N. The Army terminal program office is located in Communications-Electronics Command's Single Channel Objective Tactical Terminal Project Office, Fort Monmouth, NJ. The Army Milstar terminal effort is contained in Program Element 33142A. Space Division is responsible for DT&E of the Space and Mission Control Segments of the Milstar System. The responsible agency for the Space and

and Mission Control Segments Initial Operational Test and Evaluation (IOT&E) is the Air Force Operational Test and Evaluation Center (AFOTEC). Air Force Space Command is designated the system operator and will be responsible for operation of the Milstar satellite constellation as well as the Mission Control Segment. Air Force Logistics Command will be responsible for maintenance of the Mission Control Segment.

(U) Lockheed Missiles and Space Company, Sunnyvale, CA, is under contract to Space Division for the general systems engineering and the Space and Mission Control Segments. The Air Force airborne and ground communications terminals are being developed by Raytheon in Sudbury, MA. The Navy's seaborne terminals are being developed by Raytheon in Sudbury, MA. The Army terminals are being developed by Magnavox, Ashburn, VA.

2. (U) Operational Test and Evaluation (OT&E):

(U) Responsible Organizations: AFOTEC has been designated the lead agency for conducting a multiservice IOT&E program for the overall Milstar system. AFOTEC, the Army Operational Test and Evaluation Agency (OTEA), and the Navy Commander, Operational Test and Evaluation Force (COMOPTEVFOR), will participate in the multiservice IOT&E which will take place as a combined Development Test and Evaluation (DT&E)/OT&E effort. A multiservice test team will be formed with representatives from Air Force, Army, Navy, and the Defense Nuclear Agency (DNA) to conduct the IOT&E testing.

(U) Test Approach. A system/mission oriented test approach has been developed which will test the Milstar system from the perspective of its capability to satisfy end-to-end mission communications requirements. Testing will be conducted in two phases. The first phase will involve participation in final in-plant DT&E, particularly the system end-to-end test, and field test with Developmental Flight Satellite #1 (DFS-1) on-orbit. Testing in Phase I will be conducted as both a combined DT&E/IOT&E and a dedicated IOT&E. Phase II will involve field tests with DFS-2 on-orbit and will be conducted as a dedicated IOT&E. In both Phase I and Phase II testing, the approach will be to establish and test communications networks which are as representative as possible of networks required in the Joint Milstar Communications and Control Operations Concept. The network testing will evaluate terminal interoperability (terminals of all three services) and system connectivity in realistic network communications scenarios. Two reports will be provided, an interim report at the completion of Phase I test and a final report at the completion of Phase II test. Each service will prepare and staff independent evaluation reports. In addition, the services will prepare and staff a joint report which consolidates the findings of all three services.

(U) Test Planning: AFOTEC, in conjunction with OTEA and COMOPTEVFOR, is accomplishing early IOT&E planning.

(U) The critical issues were prepared and coordinated with the Army, Navy, and Marine Corps.

(U) The Test Program Outline (TPO) was prepared and includes resources from Air Force, Army, and Navy.

(U) The Multiservice test approach was prepared by AFOTEC and coordinated with Army, Navy, and Marine Corps.

(U) The Multiservice Test and Evaluation Master Plan will be submitted on 31 Dec 86 for OSD review/approval.

Budget Activity: 3, Strategic Programs
Program Element: 33603F, Milstar Satellite Communications System (Space and Mission Control)

Planned IOT&E: Testing will commence in early [ ] with Phase I and continue through Phase II test with Developmental Flight Satellite #2 (DFS-2) on-orbit. Key events are:

(1) (U) Publish Milstar Multiservice IOT&E Test Plan - Oct 88

(2) ( ) Form Multiservice Test Team - [ ]

(3) ( ) First Test Event - [ ]

(4) ( ) Phase I Test Report - [ ]

(5) ( ) Final Test Event/Final Test Report - [ ]

(6) ( ) Report Briefings - [ ]

(7) ( ) Dissolve Test Team - [ ]

3. (U) System Characteristics:

Characteristic	Objective/Threshold	Demonstrated
(U) Survivability		
( ) Jam Resistant	[ ]	Future Tests
( ) Low Probability of Intercept	[ ]	Future Tests
( ) Nuclear Scintillation	[ ]	Future Tests
(U) Performance		
( ) Capacity	Nominally [ ]	Future Tests
( ) Constellation Time Control	[ ]	
( ) Constellation Ephemeris Control	[ ]	Future Tests
(U) Mission Control Element (MCE) Mean Time Before Failure	600 hours	Future Demonstration

Budget Activity: 3. Strategic Programs
Program Element: 33603F, Milstar Satellite Communications System (Space and Mission Control)

4. Current Test and Evaluation (T&E):

T&E Activity (Past 12 Months)

Event	Planned Activity	Actual Date	Remarks
Mission Control Element:			
			Continuing Program
			Continuing Program
Satellite:			
			Continuing Program
			Continuing Program
			Continuing Program
Briefed New System Test Approach	Feb 86	Mar 86	
Complete Test Program Outline Revision	Feb 86	Feb 86	

T&E Activity (Next 12 Months)

Event	Planned Date	Remarks
Mission Control Element		

Budget Activity: 3, Strategic Programs
Program Element: 33603F, Milstar Satellite Communications System (Space and Mission Control)

T&E Activity (Next 12 Months) (Cont)

Event	Planned Date	Remarks
Satellite		
Complete Revised Test and Evaluation Master Plan	FY 87	To reflect new system test concept

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 41123F
DOD Mission Area: 265 - Intratheater Airlift

Title: Military Airlift Group (IF)
Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		18,533	8,664	12,415	192	0	39,804

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Air Force One Replacement Program is designed to replace the existing Air Force One aircraft (Boeing 707 models) which are 14 and 24 years old, respectively. They are becoming increasingly difficult to maintain and support as the number of Boeing 707s in commercial airline service worldwide is declining and is expected to approach zero by 1990. In addition, the existing aircraft need improved communications equipment, range, performance and payload, and do not meet Federal Aviation Administration noise standards. The present aircraft are space limited and cannot accommodate present or future requirements. These requirements include adequate work/rest space for the President, his staff and the aircrew, and an emergency treatment medical facility. In an effort to reduce ground support requirements, the replacement aircraft will include self-contained steps, automated baggage loading equipment and auxiliary power units capable of operating all onboard equipment and maintaining a comfortable environment while the aircraft is on the ground. After a competitive source selection, the Secretary of the Air Force chose the B-747-200B as the winner of the competition. A maintenance and support complex must be built at Andrews AFB, MD, to support the two new aircraft.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	19,490	8,963	12,677	N/A	195	41,325
Aircraft Procurement	280,000	74,400	7,400	N/A	0	361,800

EXPLANATION: (U) Gramm-Rudman-Hollings (G-R-H) reduced FY 1986 RDT&E funds by $957 thousand which accounts for the differences between the FY 1987 and the FY 1988/1989 Descriptive Summary "FY 1986 Actual" and "Total Cost" columns. Aircraft procurement differences can be attributed to G-R-H which reduced aircraft procurement by $13.72 million in FY 1986, to Congressional direction to fund initial spares ($39.9 million in FY 1987 and $7.4 million in FY 1988) from FY 1986 spares appropriations (of which the Air Force needed only $39.9 million), and to competition which saved $34.5 million in FY 1987, thus increasing the "FY 1986 Actual" column and zeroing the "FY 1987 and FY 1988 Estimate" columns.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

Aircraft Procurement						
Funds	306,180	0	0	0	0	306,180
Quantity	2	0	0	0	0	2

Program Element: 41123F
DOD Mission Area: 265 - Intratheater Airlift

Title: Military Airlift Group (IF)
Budget Activity: 3 - Strategic Programs

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Military Construction Funds	0	25,000	20,000	0	0	45,000

5. (U) RELATED ACTIVITIES: The Air Force has contracted with E-Systems to upgrade the communication systems of six aircraft in the Special Air Mission fleet at Andrews AFB, MD. This program is known as the mid-term upgrade of the Mission Communication System (MCS). Under this contract, E-Systems will develop a switch to function as the heart of the MCS and will provide six ship sets designed for installation in the narrow-body aircraft at Andrews. The mid-term upgrade of the MCS system is considered to be the baseline communications system for the replacement aircraft. E-Systems will modify two of these six ship sets for installation into the replacement, wide-body, Air Force One aircraft.

6. (U) WORK PERFORMED BY: Air Force Systems Command's System Program Office at Aeronautical Systems Division, Wright-Patterson Air Force Base OH. The prime contractor for the replacement aircraft is the Boeing Military Airplane Company, Wichita, KS.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: PE 41123F, Air Force One Replacement Program

A. (U) Project Description: This project replaces the primary and backup Presidential aircraft with two, new, B-747-200B aircraft. These off-the-shelf aircraft will require extensive redesign for interior accommodations, self-contained steps, electromagnetic pulse (EMP) hardening and the communications suite. In addition, the aircraft will require both EMP (component-level) testing and flight testing.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Awarded acquisition and contractor logistics support contracts to the Boeing Military Airplane Company on 7 July and 16 July 1986, respectively. Finalized aircraft interior design concept and began the design and integration effort for the interior accommodations, communications system, avionics equipment and EMP hardening of the flight controls and the mission essential communications equipment.

(2) (U) FY 1987 Program: FY 1987 RDT&E funds will be used to redesign the B-747-200B airframe and its propulsion and avionics systems, as well as to design the MCS configuration and aircraft interior. Funds will also be required for EMP hardening, systems test and evaluation, systems engineering and program management, mission support and other government costs.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Continue the design and integration effort for the interior accommodations, communication system, and avionics equipment and perform systems-level testing of the electromagnetic pulse-hardened communication system, avionics, and flight controls to ensure that we have the proper levels of protection. We will also flight test the aircraft to include antenna installation, pattern and flutter testing, electromagnetic interference/compatibility, infrared suppression, and smoke and fume elimination due to the unique aircraft interior. In addition, we must certify the Category III microwave landing system, the electronic flight instrument system and the navigation system and perform engine qualification testing. RDT&E costs also include funds for overhead engineering and laboratory test support. The FY 1988 RDT&E program is considered Confidence Level III, Budgetary.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Final RDT&E funding increment which will be used for the development of the global positioning system (GPS) and the infrared countermeasure (IRCM) system for the Air Force One replacement aircraft. The FY 1989 RDT&E program is considered Confidence Level IV, Planning.

(5) (U) Program to Completion: RDT&E funds are not required beyond FY 1989.

C. (U) Major Milestones:

		Milestones	Dates
(1)	(U)	Received Program Go-Ahead	15 August 1985
(2)	(U)	Released Request for Proposals to Industry	31 December 1985
(3)	(U)	Awarded Acquisition Contract	7 July 1986
(4)	(U)	Awarded Contractor Logistics Support Contract	16 July 1986
(5)	(U)	Completed Preliminary Design Review	24 October 1986
(6)	(U)	Award Construction Contract for Maintenance and Support Complex	10 March 1987
(7)	(U)	Conduct Critical Design Review	17 July 1987
(8)	(U)	Complete Qualification Test and Evaluation/Qualification Operational Test and Evaluation	31 August 1988
(9)	(U)	Complete Maintenance and Support Complex	30 September 1988
(10)	(U)	Deliver First Aircraft	30 November 1988
(11)	(U)	Deliver Second Aircraft	31 May 1989

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63230F
DOD Mission Area: 221 - Counterair

Title: Advanced Tactical Fighter (ATF)
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		152,204	248,821	536,826	702,995	1,318,416	3,104,166
2472	Advanced Tactical Fighter	2,954	62,300	84,075	182,228	528,716	872,337
2878	Advanced Tactical Fighter Engine	138,250	147,821	388,774	413,156	384,694	1,597,815
2995	Critical Subsystems Development	11,000	38,700	63,975	107,611	405,007	636,014

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The ATF program will develop the next generation air superiority fighter for introduction in the mid-1990's to counter the emergence in large numbers of advanced Soviet fighters. The ATF is being designed to penetrate enemy airspace and achieve a first-look, first-kill capability against multiple targets. Program emphasis from the outset has been balanced on affordability, reliability/maintainability, performance and survivability. To develop and mature the advanced concepts and technologies required in this next-generation fighter prior to its entering Full Scale Development (FSD), hardware demonstrations and risk reduction efforts will be accomplished in each of the three major ATF projects. The pre-FSD phase of the program has been restructured and extended to incorporate the fabrication and demonstration of a ground-based prototype avionics integration laboratory and construction and flight testing of prototype air vehicle designs.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E						
FY 1987 PB	164,628	294,099	343,520	N/A	N/A	1,139,607

EXPLANATION: (U) During formulation of the FY 1988 budget this hardware demonstration/risk reduction program was restructured and extended to incorporate the fabrication and testing of air vehicle prototypes and ground-based avionics systems. Start of Full Scale Development (FSD) was moved from FY 1989 to FY 1991.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable

5. (U) RELATED ACTIVITIES: The Advanced Tactical Fighter program is related to the Advanced Fighter Technology

Integration (AFTI) program (PE 63205F and PE 63245F) which will develop technology for integrated avionics suites, digital flight controls and aerodynamic refinements to meet the need of the next generation fighters. The AFTI program is currently flight testing an F-16 with a highly integrated flight/fire control system to demonstrate greater capability and survivability in unguided weapons delivery and air-to-air combat. Using an F-15, the AFTI program will also demonstrate an advanced two-dimensional thrust vectoring/reversing engine nozzle and integrated flight and propulsion controls for enhanced maneuvering performance and effective short takeoff and landing capability. The Integrated Electronics Warfare System/Integrated Communication, Navigation, Identification Avionics program (PE 63109F) will exploit a number of recent innovations in systems architecture, Very High Speed Integrated Circuit semiconductor technology, computarization and computer software to integrate and automate avionics functions for the ATF. Advanced and engineering development for the ATF training systems is funded in PE 64227F, Flight Simulator Development. After the the Milestone II Full Scale Development decision in FY 1991, ATF development efforts will be funded in PE 64239F, ATF Engineering. Initial long lead procurement will be funded in PE 27219F, Advanced Tactical Fighter.

6. (U) WORK PERFORMED BY: Technology and advanced development efforts for ATF are being managed by the Air Force Systems Command/Aeronautical Systems Division, Wright-Patterson AFB, OH. Contractors for the FY 1983/FY 1984 concept definition studies were Boeing Aerospace Corp, Seattle, WA; General Dynamics Corp, Fort Worth, TX; Grumman Aircraft Company, Bethpage, NY; Lockheed California Company, Burbank, CA; McDonnell Aircraft Company, St Louis, MO; Northrop Corp, Hawthorne, CA; and Rockwell International, Los Angeles, CA. Lockheed California Co, Burbank, CA; and Northrop Corp, Hawthorne, CA have been selected as the prime weapon system contractors for the Demonstration/Validation (Dem/Val) phase. As a result of teaming agreements developed during the Dem/Val source selection, Boeing and General Dynamics will be principal subcontractors to Lockheed and McDonnell Aircraft Co will be principal subcontractor to Northrop. The advanced engine development is also being managed by the Air Force Systems Command/Aeronautical Systems Division, Wright-Patterson AFB, OH. Engine development contractors are Pratt and Whitney Aircraft Group of West Palm Beach, FL and the General Electric Co, of Evendale, OH.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not applicable

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2472, Advanced Tactical Fighter

A. (U) Project Description: This project continues development of the next generation air superiority fighter aircraft design with the performance and survivability features required to counter advanced Soviet fighters that will appear in large numbers in the early 1990's. In this advanced development project, flight vehicle technologies, design concepts, subsystem approaches, advanced materials, etc, that will be important to achieving ATF program and capability objectives will be demonstrated and validated. This will be accomplished through the use of tradeoff analysis, detailed design work, wind tunnel and radar cross section tests, materials and component design tests, as well as hardware demonstrations including fabrication and flight testing of air vehicle prototypes.

B. (U) Program Accomplishments and Future Efforts:

Program Element: 63230F
DOD Mission Area: 221 - Counterair

Title: Advanced Tactical Fighter (ATF)
Budget Activity: 4 - Tactical Programs

(1) (U) FY 1986 Accomplishments: In February 1986, in response to a Request for Proposal issued in October 1985, the seven major airframe contractors that participated in ATF concept definition studies submitted proposals for the advanced development phase of the ATF program. On 31 Oct 86 the Secretary of the Air Force announced the selection of Lockheed and Northrop as the winning contractors for the Dem/Val phase. These contractors have formed teams as noted earlier and will refine their designs, perform "proof of concept" tests, hardware and software demonstrations, and produce and test flying prototypes.

(2) (U) FY 1987 Program: Contract awards were preceded by a Joint Requirements and Management Board (JRMB) Milestone I review. In mid-FY 1987 a Systems Requirements Review (SRR) will be held in which system level design information and the contractors' plans for building the prototype avionics demonstrator and aircraft will be reviewed. The designs will be used to develop a preliminary overall system specification for ATF. Advanced materials tests, subscale wind tunnel and radar cross section models test and system supportability demonstrations will begin in FY 1987. Initial fabrication of prototype components will begin.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Detailed design and fabrication of ATF prototype aircraft will continue. Materials tests of critical sub-assemblies will be initiated. Full scale radar cross section tests will be conducted and wind tunnel tests will proceed on large scale inlets and aerodynamic models.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: In FY 1989 fabrication of the prototype flight vehicles will be completed and integration of propulsion, flight control subsystems, and flight test instrumentation initiated. First flight of the prototypes will occur in late FY 1989 or early FY 1990.

(5) (U) Program to Completion: Flight tests of prototype aircraft will continue through FY 1990. In early FY 1991 a contract will be awarded to a single airframe contractor/team for the FSD phase of the program.

C. (U) Major Milestones:

Milestones		Dates
(1) (U) Mission Element Need Statement approved by Defense Resources Board		November 1981
(2) (U) Technology and Concept Development Contract Awards		September 1983
(3) (U) Release of Demonstration/Validation Request for Proposal		October 1985
(4) (U) Milestone I (Requirements Review)	*(3rd Quarter FY 1986)	4th Quarter FY 1986
(5) (U) Milestone II (FSD and Long Lead Decision)	*(1st Quarter FY 1989)	1st Quarter FY 1991
(6) (U) First Flight (FSD aircraft)	*(3rd Quarter FY 1991)	3rd Quarter FY 1993
(7) (U) Milestone III (High Rate Production Decision)	*(1st Quarter FY 1992)	4th Quarter FY 1994
(8) (U) Initial Operational Capability (IOC)	*(4th Quarter FY 1995)	2nd Quarter FY 1996

*Date presented in FY 1987 Descriptive Summary

(U) Explanation of Milestone Changes

(4) (U) Milestone I slipped one quarter as a result of modification of the Request for Proposals.
(5) (U) Milestone II slipped over two years due to delays in start of Demonstration/Validation (Dem/Val) phase and to expand the scope of that effort to incorporate prototypes.
(6) (U) First flight of the FSD aircraft delayed two years due to delay of the start of FSD.
(7) (U) Milestone III delayed one year because of the delay in start of FSD. (Milestone III in the FY 1987 Descriptive Summary referred to the Low Rate Production decision.)
(8) (U) IOC slipped six months as a result program restructure and delays in start of Dem/Val.

9. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2878, Advanced Tactical Fighter Engine (ATFE)

A. (U) Project Description: The advances in propulsion technology sought in the ATFE project will be essential to achieving the significant capability improvements needed in the next generation air superiority fighter, including efficient supersonic cruise, increased reliability, and reduced logistics support. This project funds a competitive prototype engine demonstration of two advanced engine designs. To support the flight demonstration of prototype ATF aircraft with ATFE engines prior to FSD, this project has been restructured to obtain flight release of prototype engines in the FY 1989-1990 timeframe.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Funding for FY 1986 completed the fabrication of the first demonstration engines and initiated testing. Efforts to adapt the design of ground-based demonstration engines for use in prototype air vehicles was initiated.

(2) (U) FY 1987 Program: Fabrication of engines for the prototype aircraft will be initiated. Testing of ground demonstration engines will continue. ATF system specifications resulting from the System Requirement Review in mid-FY 1987 will be used to define specifications for the FSD engine/nozzle and initiate its detailed design. Mechanical operability and performance tests of competing demonstrator engines will be conducted.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Detailed design of FSD engines will continue and long lead release of FSD engine materials will occur. Operability and performance tests will be initiated on the engines for the prototype aircraft.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Performance and durability tests will be completed on prototype aircraft engines in FY 1989. Flight release of these engines will be obtained in FY 1989. Fabrication of FSD engines will begin.

(5) (U) Program to Completion: First flight of the prototype air vehicles with the prototype engines will occur in early FY 1990.

C. (U) Major Milestones: The relevant milestones for the Advanced Tactical Fighter Engine project are the same as those shown for the Advanced Tactical Fighter project.

10. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2995, Critical Subsystems Development (CSD)

A. (U) Project Description: The purpose of this project is to demonstrate that certain subsystems employing advanced technologies critical to the development of the ATF can be successfully integrated into an effective system. Several critical technologies in weapons integration, avionics integration and advanced radar/sensor development must be matured prior to aircraft design freeze. The state-of-the-art microelectronics, sensors, advanced integrated avionics subsystems, and weapons systems developed for ATF in this project will make it possible to process extraordinary amounts of sensor data and vastly improve the pilot's capabilities for threat definition, situational awareness, aircraft fire and flight control, weapon/countermeasure systems management, etc. This project began in FY 1985 and will be completed in time to support a FSD decision in FY 1991.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Integrated avionics architecture studies under Pave Pillar were completed with a critical design review in late FY 1986. Results will be used to form the initial ATF avionics architecture specifications baseline. Source selection was conducted by weapon system subcontractors to identify contractors to participate in the ATF hardware demonstration phase to include radar/electro-optical (EO) sensor definition and trade studies. Internal weapon carriage studies continued.

(2) (U) FY 1987 Program: The avionics architecture specification and ATF System Requirements Review (SRR), to be completed in mid-FY 1987, will be used as a basis for initiating the design and fabrication of a ground-based avionics prototype as well as installation and flight test in avionics test bed aircraft. These will serve as the pre-FSD systems integration and testing laboratories for the ATF avionics architecture, subsystems, and data processing modules. ATF system specifications from SRR will also be used to define preliminary subsystem parameters for the radar/EO sensors.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Development of the avionics integration prototype laboratory will continue with initial integration tests and simulations. Advanced development modules (ADM) of avionics components and subsystems (e.g., 1750 data processors, high speed data bus, common signal processor modules, etc.) will be integrated and demonstrated as an operating system. Design and fabrication of prototype sensor components and subsystems will be conducted. Large scale wind tunnel tests of weapons bay separation will be initiated.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: In FY 1989 additional ADM hardware will be incorporated into the avionics integration prototype, possibly including components from the Integrated Electronic Warfare System/Integrated Communications, Navigation, Identification Avionics (INEWS/ICNIA) program (PE 63109F). Fabrication of prototype sensor components and subsystems will be completed and ground and roof top tests will begin.

(5) (U) Program to Completion: Tests verifying fault isolation/fault tolerance and other key aspects of the integrated avionics architecture will be performed. In addition, critical elements of the avionics architecture will be flight demonstrated operating as an integrated system in avionics test bed aircraft. In FY 1990-1991, subsystem specifications for the sensor suite will be finalized and fabrication of components will be initiated, aiming at delivery of full-scale development sensors in FY 1993-1994. Weapons bay separation test will be conducted using the prototype ATF air vehicles.

C. (U) Major Milestones: The relevant milestones for the Critical Subsystems Development project are the same as those shown for the Advanced Tactical Fighter project.

11. (U) COOPERATIVE AGREEMENTS: Not applicable

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63239F — Title: Unmanned Air Reconnaissance System
DOD Mission Area: 327 - TIARA for Tactical Air Warfare — Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		8,543*	3,809	8,812	8,831	Continuing	N/A

* Prior to FY 1987 this Program Element (PE) included funds for development of an electro-optical (EO) sensor, data link, recorder, ground station, and concept definition of an unmanned vehicle. In FY 1987, the EO sensor, data link, recorder, and ground station are funded under PE 27217F.

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Advanced Tactical Air Reconnaissance System (ATARS) is an advanced development program to meet the needs of tactical commanders for detection, location and classification of tactical targets with sufficient responsiveness, location accuracy and detail to permit the timely delivery of appropriate air or ground launched weapons. The ATARS Mission Element Need Statement, May 1981 and the corresponding Justification for Major System New Start, as approved by the Office of the Secretary of Defense in August 1982, identify the requirement for near-real-time intelligence information. These requirements will be met by a mix of manned and unmanned tactical reconnaissance vehicles. This PE will fund Air Force unique requirements for a medium-range unmanned reconnaissance system being developed under Navy lead. An Air Force Statement of Requirement for an Unmanned Air Reconnaissance Vehicle (UARV) was published in March 1985. A Statement of Operational Need (SON) (Tactical Air Force SON 307-85) for a UARV was validated in November 1986.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	9,745	3,940	0	N/A	Continuing	N/A

EXPLANATION: (U) FY 86 decrease was due to Gramm-Rudman and other undistributed reductions. FY 88 increase was the result of the restructuring of Air Force priorities.

4. (U) OTHER APPROPRIATION FUNDS: Not applicable.

5. (U) RELATED ACTIVITIES: The Air Force has a Memorandum of Agreement (MOA) with the Navy, and under this MOA the Air Force has the lead in EO sensor development and the Navy has the lead in development of the unmanned vehicle. Navy development is funded by PE 64511N, Remotely Piloted Vehicles. Air Force development of the EO sensor, data link, recorder, and ground station is funded under PE 27217F, Tactical Air Reconnaissance System. The EO sensor, data link,

and recorder are being designed for carriage in manned and unmanned tactical reconnaissance vehicles. The ground station will be developed using modular technology from the Advanced Deployable Digital Imagery Support System (ADDISS). The ground station will be common to Air Force manned and unmanned tactical reconnaissance vehicles.

6. (U) WORK PERFORMED BY: Contractors for the overall program have not been selected. The Aeronautical Systems Division (ASD), Wright-Patterson AFB, Ohio, has overall in-house responsibility for system development and study efforts.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 63239F, Unmanned Air Reconnaissance System

A. (U) Project Description: This program funds unique Air Force RDT&E requirements for a medium-range unmanned reconnaissance vehicle, which is being developed by the Navy. These unique requirements include: airborne launch from an Air Force tactical fighter type aircraft; integration of the electro-optical (EO) sensor, data link, and recorder being developed for Air Force manned and unmanned tactical reconnaissance applications; and testing of the unmanned vehicle/EO sensor suite combination.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Demonstration and validation phase focused on environmental testing and evaluation of EO-backed cameras (film cameras modified with EO sensor capability), recorders and data link carried internally in a reconnaissance pod on an F-16. Program validated EO sensor effectiveness in a reconnaissance pod environment at low, medium and high altitudes and evaluated exploitation requirements using a ground station testbed. In FY 1987, the follow-on to these efforts will be funded under PE 27217F. For the Unmanned Air Reconnaissance System (UARS), a Request For Proposal was released by the Navy for development of a medium-range unmanned reconnaissance system to meet Navy and Air Force requirements.

(2) (U) FY 1987 Program: Conduct engineering design studies to ensure the common Air Force EO sensor suite being developed for manned aircraft is compatible with the unmanned reconnaissance vehicle, and conduct a launch aircraft interface study. Also, two unmanned vehicle contractors will be selected to participate in a competitive fly-off.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The Air Force will participate with the Navy in the flight testing of the unmanned vehicles. This PE will fund testing of unique Air Force requirements, to include air launch from RF-4 aircraft, and specific Air Force unmanned vehicle mission profiles. Costs are Category IV, and are based on preliminary analysis and estimates made in 2Q FY 86. Estimates are based on open competition followed by multiyear procurement.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Form, fit, and function testing of the

common Air Force electro-optical (EO) sensor suite in the unmanned vehicle will commence. Following the Limited Production Decision (Milestone IIIA), the Air Force will purchase three vehicles and three EO sensor suites in order to conduct Development Test and Evaluation (DT&E) of the unmanned vehicle/EO sensor suite combination in FY 90.

(5) Program to Completion: Full Production Decision (Milestone IIIB) and DT&E of the unmanned vehicle/EO sensor suite combination. Continued flight testing and training prior to delivery of the first combat coded systems.

C. (U) Major Milestones:

		Milestones		Dates
(1)	(U)	Advanced Tactical Air Reconnaissance System Mission Element Need Statement		May 1981
(2)	(U)	Justification for Major System New Start		August 1982
(3)	(U)	Program Initiation		October 1985
(4)	(U)	Limited Production Decision	*(July 1989)	October 1988
(5)	(U)	Full Production Decision	*(July 1991)	October 1989
(6)		Initial Operational Capability		

*Date presented in FY 1987 Descriptive Summary.

(U) Explanation of Milestone Changes

(4 & 5) (U) Dates adjusted to coincide with Navy milestone dates.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not applicable.

9. (U) COOPERATIVE AGREEMENTS: Not applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63256F — Title: CV-22A
DOD Mission Area: 265 - Intratheater Airlift — Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		2,252	8,633*	32,025	25,584	65,477	134,831

* Includes FY 1987 Supplemental Request of $6.7 million.

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The CV-22A will provide the Air Force Special Operations Forces (SOF) with the ability to conduct long-range infiltration, resupply, and exfiltration missions requiring vertical/short takeoff and landing (V/STOL) capabilities in the 1990's and beyond. The CV-22A is needed to conduct the deep exfiltration missions at night and in adverse weather that cannot be accomplished by current SOF assets. In addition, the CV-22 will complement present Air Force SOF aircraft in SOF infiltration and resupply missions. While the Navy is funding the airframe and engine development, Air Force funding is for development, integration, and testing of systems unique to the SOF mission. Production of a minimum of 55 aircraft starts in FY 1992 with first delivery and initial operational capability (IOC) (six aircraft) in FY 1994.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	2,252	4,920	4,800	N/A	TBD	TBD

EXPLANATION: (U) The difference in FY 1987 reflects the FY 1987 Supplemental Request. The difference in FY 1988 supports increased Air Force funding required to meet the FY 1994 SOF IOC.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable

5. (U) RELATED ACTIVITIES: The Air Force is a participating Service in the Navy-led V-22 program. Funding responsibilities are discussed in paragraph 2. Development of a multimode radar with application for CV-22A and HV-22 low level, adverse weather operations is being pursued in PE 64219F, Integrated Digital Avionics.

6. (U) WORK PERFORMED BY: On 2 May 1986, the team of Bell Helicopter Textron, Ft. Worth, TX, and Boeing Vertol, Ridley Park, PA, was awarded the full-scale development contract leading to first flight in June 1988 and delivery of the first CV-22A in late 1993. The principal RDT&E agency is Naval Air Systems Command, Washington, D.C. Primary Air Force support will come from the Aeronautical Systems Division at Wright-Patterson AFB, OH.

PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: PE 63256F, CV-22A

A. (U) Project Description: This effort will result in a CV-22A configured to satisfy Special Operations Forces (SOF) mission requirements. Starting with the baseline Marine aircraft, we will provide the contractor with additional communication, navigation, and electronic warfare equipment for integration and testing. External fuel tanks will be developed and tested to extend operational range. In addition, logistics support and training aspects of these Air Force unique systems will be developed to give us aircraft optimally suited for the SOF mission.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Navy full scale development contract award was made on 2 May 1986. The Air Force worked closely with the Navy program office to define the Air Force CV-22A configuration. Specific activities included definition of avionics architecture and new systems development requirements, completion of an electronic warfare (EW) study applicable to the CV-22A use in the SOF mission and evaluation of the contractor proposals for full scale development. SOF equipment was procured and integration begun in a systems integration lab (SIL) in preparation for testing in FY 1988. Activities were initiated to support dynamic simulation of crew station tasks essential to the successful completion of the SOF mission. Efforts were started to evaluate external fuel tank configurations to assure the aircraft will meet SOF range requirements.

(2) (U) FY 1987 Program: A FY 1987 Congressional cut may cause delay of certain previously planned activities unless the FY 1987 Supplemental Request is approved or additional funds are reprogrammed by the Air Force. Reduced quantities of government furnished equipment will be purchased and integrated in the SIL. Several external fuel tank configurations will be designed, but wind tunnel testing of those tanks may be delayed until FY 1988. An engine structural integrity program will be initiated to determine the durability of the Allison engine as it enters the Air Force inventory. Air Force operational testing will be initiated in the areas of training and logistics support analysis. Extensive Air Force involvement in the airframe, fuel tank, and engine development/integration will be needed to ensure our mission requirements are satisfied.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Testing of six prototype air vehicles by a combined contractor/government team will be started. Emphasis will be placed on verifying actual system performance through joint and integrated test and evaluation. Air Force peculiar efforts include avionics integration of SOF unique systems such as a medium accuracy inertial navigation system and the multimode radar developed under PE 64219F, Integrated Digital Avionics. Procurement and integration of electronic warfare systems will begin to provide the CV-22A with an interactive suite able to be operated by the two primary aircrew members. External fuel tank wind tunnel testing will determine which tank is most operationally and fiscally effective; this tank will be fully developed and prepared for flight test. The engine structural integrity program will continue. Other non-avionics systems will also be procured and integrated for flight test in FY 1990. Cost estimates for these efforts are Category II, mature.

Program Element: 63256F Title: CV-22A
DOD Mission Area: 265 - Intratheater Airlift Budget Activity: 4 - Tactical Programs

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Flight testing of the prototype V-22s will continue with Air Force involvement. Procurement and integration of Special Operations Forces (SOF) unique equipment such as navigation, communication, electronic warfare equipment, external fuel tanks, and other non-avionics type systems will be completed so that development flight testing can begin in FY 1990 and initial operational flight testing can begin in FY 1991.

(5) (U) Program to Completion: Development Test and Evaluation/Operational Test and Evaluation will continue to be a combined contractor/government effort. V-22 Production Release begins in FY 1990 for the Marine Corps. Production Release for the Navy and Air Force is in FY 1992 leading to Air Force SOF Initial Operational Capability in FY 1994. Delivery of a minimum of 55 aircraft for the Air Force will be completed in FY 1998.

C. (U) Major Milestones:

Milestones		Dates
(1) (U) Preliminary Design Contract Award		April 1983
(2) (U) Full Scale Development (FSD) Contract Award	*(March 1986)	May 1986
(3) (U) Long Lead Release (USMC)		3rd Quarter FY 1987
(4) (U) Operational Test and Evaluation		2nd Quarter FY 1991
(5) (U) Full Production Release	*(4th Quarter FY 1991)	1st Quarter FY 1992
(6) (U) First USAF Delivery	*(4th Quarter FY 1993)	1st Quarter FY 1994
(7) (U) USAF Initial Operational Capability		4th Quarter FY 1994

* Date presented in FY 1987 Descriptive Summary

(U) Explanation of Milestone Changes

(2) (U) FSD Contract Award slipped six weeks due to need for additional review by the Office of the Secretary of Defense prior to the Defense Systems Acquisition Review Council meeting on 17 April 1986.
(5) (U) Full Production Release slipped 90 days due to restructure of FSD contract.
(6) (U) First USAF Delivery slipped 90 days due to restructure of FSD contract.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63260F
DOD Mission Area: 312, General Defense Intelligence Program

Title: Intelligence Advanced Development
Budget Activity: 5-Intelligence & Communications

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		0	4,912	5,074	5,796	Continuing	N/A
3479	Advanced Sensor Exploitation	0	1,200	1,250	1,300	Continuing	N/A
3480	Automated Imagery Exploitation	0	1,700	1,600	1.900	Continuing	N/A
3481	Knowledge Based Technology For Intelligence	0	1,200	1,400	1,700	Continuing	N/A
3482	Scientific & Technical Intelligence Methodologies	0	800	800	900	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element develops and demonstrates advanced technology for intelligence systems capabilities and techniques which support tactical and strategic combat commanders and the National Command Authority (NCA) needs for timely and all-source intelligence information. The program objectives are to develop improved analytical techniques and training systems to support USAF warfighting missions, to expand and improve intelligence data storage, retrieval and handling capabilities, and to satisfy needs for near-real-time data processing, exploitation and dissemination from present and future advanced sensors. The program element is oriented toward solving specific shortfalls and deficiencies as defined by Air Force major commands, unified and specified (U&S) commands, and Scientific and Technical (S&T) Intelligence organizations.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	0	6,081	7,790	N/A	Continuing	N/A

EXPLANATION: (U) Congressional reduction of funds in FY 1987. Due to fiscal constraints, AF reduced funding in FY 1988.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable

5. (U) RELATED ACTIVITIES: Related Program Elements include: 64750F, Intelligence Equipment; 62702F, Command, control and Communications; 63742F, Combat Identification Technology, for emergent technology; 12310F, WWMCCS ADPNORAD:

27411F, EIFEL Improvements; 27412F, Tactical Air Control System Improvements; 27422F, Tactical Air ControlSystem communications; 27431F, Tactical Air Intelligence Systems; 64321F, Joint Tactical Fusion Program; 27435F, Tactical Imagery Processing, Exploitation and Dissemination; 33152F, WWMCCS Information System; 63208F, Reconnaissance Sensor Development; 63718F, Electronic Warfare; 63789F, Command, Control & Communications Advanced Development and 63726F, Optic Development for engineering development of demonstrated solutions to operational requirements. Projects within this program element are coordinated with Army, Navy, Marine Corps and other DOD activities.

6. (U) WORK PERFORMED BY: The program is managed by Air Force Systems Command, Andrews AFB, MD, with project efforts being conducted by Rome Air Development Center (RADC), Griffiss AFB, NY.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project 3479, Advanced Sensor Exploitation (ASE): The ASE program was inititated to develop a correlation and processing capability utiliizing multi-sensor products as inputs. The goal of the ASE program is near-real-time all source correlation fusion using expert systems for receipt, correlation, templating and analysis of sensor data. In FY 1986, development continued on correlation/fusion algorithms to support the Joint Tactical Fusion Program (JTFP). A Budget Estimate Agreement (BEA), 13 May 1986, established a working relationship between the JTFP Program Management Office and the Rome Air Development Center (RADC) for the purpose of insuring exploratory and advanced development activities and to insure the orderly transition of appropriate software to the JTFP office. In addition, the BEA will provide a testbed environment to test and evaluate software (other sources) prior to transition to the JTFP. Activities in FY 1986 were accomplished under PE 63789F (Command, Control Communications, Advanced Development) Project 2315. In FY 1987, the ASE Program was transferred to PE 63260F, Intelligence Advanced Development. Under the ASE project, development of operational, intelligence data correlation, algorithms continued and enchancements to the ASE testbed (senario generation module, sensor simulation module, correlation & processing module) were implemented. In FY 1988-1989, efforts will continue with advanced development of artificial intelligence software/hardware for the Tactical Air Force's ASE program. This task is known as the AI situation assessment module. In addition, efforts will continue with the development of an enchanced sensor simulation package which will permit simulation of multiple sensor packages. Advanced development efforts to continue with completion of the target analysis module, the target prioritization aid, air order of battle update and completion of C3CM tactics analyzer.

B. (U) Project 3480, Automated Imagery Exploitation (AIE): The objective is to develop technology advancements required for real and near-real time multi-source imagery exploitation in a ground station environment. Advances in the technologies of automated target detection, classification, identification, advanced data handling and processing hardware will be demonstrated and evaluated on a testbed. Implementation of expert systems will provide the capability to automate imagery interpretation by augmenting human intelligence in the manpower intensive task of imagery exploitation. In FY 1986, the AIE task was accomplished under PE 63789F. Efforts initiated to develop near-real-time target detection algorithms to support emerging imagery exploitation. A draft technology transition plan, August 1986, was initiated to provide a transition vehicle for RADC technologies into the Advanced Deployable Digital Imagery Support System (ADDISS). Nine technologies were identified as potential candidates: Image compression, Image reformatting, geopositioning, auto target detection, Tactical Optical Disk, Digital cartographic applications,

classification, identification and flat panel displays. In FY 1987, the AIE Project transferred to PE 63260F, Intelligence Advanced Development. Efforts began on Intelligence Image compression to provide increased storage of multi-sensor imagery data, increased transmission of imagery through band limited channels and to limit image degradation. In addition, efforts were initiated on intel/information reformatter technology to provide a real-time capability to accept multi-sensor reconnaissance imagery and reformat into a common standard. FY 1988-1989 efforts include image compression tasks and intel/information reformatter technology task. In addition, RADC will refine the cartographic application for Tactical & Strategic System (CATSS) technology to provide the algorithms & software necessary to display and manipulate cartographic background, data geographic names and geoposition data. The planned transition date for CATSS is 1st Qtr FY 93.

C. (U) Project 3481, Knowledge Based Technology for Intelligence: The project includes several tasks designed to develop advanced computer software (expert systems) based on artificial intelligence techniques. Specific tasks include: Air Force Space Command's Aerospace Warning; The Air Force Electronic Warfare Center's EW Flagging Program; The Electronic Security's Command's Tactical Analysis Program; and the Air Force Intelligence Service's Denial & Deception Expert Systems. Four knowledge based (Expert system - Artificial Intelligence) tasks initiated to support the intelligence analyst. The objective of the Aerospace Warning task is to develop prototype advanced computer subsystem modules to provide warnings and assessment of foreign space and missile activity in the prelaunch (launch prediction), trans-launch (launch assessment) and post-launch (orbit analysis) phases. The electronic warfare flagging task will provide computer software to assist electronic-warfare analysts in a near-real-time Electronic Intelligence (ELINT) analysis and reprogramming capability. The objective of the Tactics Analysis Program is to develop computer expert system software to accelerate the analysis of foreign aircraft tactics and capabilities and provide timely dissemination to the Tactical Commands. The purpose of the Denial & Deception Expert Systems is to develop and prototype, image-based software for the Air Force Intelligence Service to assist analysts in rapid detection and monitoring of foreign D & D activities. In FY 1988-1989, follow-on efforts will continue with the Advanced Development of Artificial Intelligence Software/Hardware for AFSPACECOM's Aerospace Warning project.Development will continue on rule-based software for the Air Force Electronic Warfare Center's EW Flagging Analysis, Electronic Security Command's Tactics Analysis Program, and the Air Force Intelligence Service's Denial & Deception Task. Projects will support Air Force Intelligence functions and operational forces by improving automation of Battlefield Imagery Exploitation and Intelligence Decision Aid software.

D. (U) Project 3482, Scientific and Technical Intelligence Technology: Project includes two tasks designed to develop computer models to enhance technical analysis of foreign weapon systems. Task 01, Scientific and Technical Intelligence methodologies, supports ASFC's Foreign Technology Division (FTD) in the assessment of foreign systems. Task 02, Operational Employment Simulation Research will support FTD's computer simulation capability to provide a baseline of complete and validated digital threat definitions. In FY 1987, two tasks were initiated: Scientific and technical intelligence methodologies and operational employment simulation research. The scientific and technical intel methodologies task will aid FTD to conduct studies and present feasibility demonstrations on current foreign capabilities and potential threats. RADC will specifically initiate development of the Aircraft Avionics Analytical Model Study. The subtask will establish modeling requirements and conduct a survey of off-the-shelf software toward the development of three separate and independent computer models: Ground Attack Fighter Model, Communications/

Avionics/Navigation model and bomber/tanker penetration model. The operational employment simulation research will give FTD the capability to digitally model and simulate the performance of threat weapons in a projected operational environment. Specific applications include development of an Automated Model Evaluation Station (AMES), development of model data translator programs and the development of a data based querry language. Development will continue on coventional software for the Foreign Technology Division's operational employment simulation project. In FY 1988-1989, the aircraft avionics analytical model study and final development of the Automated Model Evaluation Station (AMES) sub task should be completed. Efforts will aid FTD to conduct studies and present feasibility demonstrations on current foreign capabilities and potential threats, and support FTD in determining the time requirements for foreign R&D to field a new technology.

E. Major Milestones: Not Applicable

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable

9. (U) Cooperative Agreements: Not Applicable

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63307F
DOD Mission Area: 214 - Ground Based Anti-Air and Tactical Missile Defense

Title: Air Base Survivability & Recovery
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	4,350	5,797	4,426	5,132	Continuing	N/A
3018	Air Base Operability	3,560	3,197	2,930	3,474	Continuing	N/A
3140	Camouflage, Concealment, and Deception	790	2,600	1,496	1,658	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Air Base Operability (ABO) integrates operational concepts with research, development and acquisition programs to improve a sustained sortie generation capability should an attack occur on or close to an air base. The Air Force must provide enough people, aircraft, facilities and key supporting systems so that theater air bases can survive an enemy attack allowing air power to be continuously and effectively employed throughout a conflict.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	4,863	7,078	5,509	N/A	Continuing	N/A

EXPLANATION: (U) Congressional reduction of funds in FY 1987. FY 1988 funding request reduced due to expected availability of prior year funding in FY 1988

4. (U) OTHER APPROPRIATION FUNDS: Not applicable.

5. (U) RELATED ACTIVITIES: The Full Scale Development efforts that follow this Advanced Development work are provided in PE 64617F, Air Base Survivability & Recovery, and continue through the Five Year Defense Plan.

6. (U) WORK PERFORMED BY: Program contractors are Computer Science Corporation, Bay St Louis, MS; Softech Incorporated, Alexandria, VA; Orlando Technology Incorporated, Orlando, FL; Verac Incorporated, San Diego, CA; and TRW Defense Systems Group, Redondo Beach, CA (all working on Air Base Survivability). There is one additional contract with a contract value of $120,000. In-house development organizations are Armament Division, Eglin AFB, FL; Aeronautical Systems Division, Wright-Patterson AFB, OH; Air Force Engineering and Services Center, Tyndall AFB, FL; and Electronic Systems Division, Hanscom AFB, MA.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 3018, Air Base Operability (ABO). Air Base Operability is a multi-faceted program with five mutually supporting elements: active defense; passive defense; base recovery; command, control, and communication survivability; and aircraft enhancements. This project provides advanced development efforts for active and passive defense, base recovery, and command, control, and communication survivability. It also funds the continuing integration, planning and technology demonstration activities of the ABO Systems Management Office (SMO). The SMO is responsible for integrating all ABO activities Air Force wide and performing cost effectiveness analyses on ABO requirements and programs for meeting them. Efforts completed in FY 1986 included: publication of the SALTY DEMO final report; incorporation of SALTY DEMO conclusions and recommendations into the SALTY DEMO Implementation Plan; initiation of modeling to predict the ability of air bases' utilities to survive conventional attacks; completion of development of a hardening kit for explosive ordnance disposal equipment; analyses to support the annual Investment Strategy Planning (ISP) meeting, VANGUARD (an Air Force long range plan), and a field assessment team visit to Misawa AB, Japan, to evaluate the base's strengths and vulnerabilities under attack; initiation of efforts to develop and demonstrate a survivable Base Recovery After Attack (BRAAT) communications network; completion of joint German/US integrated Base Rapid Runway Repair and minefield clearance trials; completion of initial testing of the effects of enemy munitions on friendly facilities. The FY 1987 funding will continue the operations and initiatives of the SMO which include: demonstration of the survivable BRAAT communications network; continuation of the development of the utility survivablity model; analyses to support the ISP meeting, VANGUARD and the field assessment team visits at other bases; expansion of effectiveness modeling to include Southwest Asia; and tests of improved Explosive Ordnance Disposal clearing equipment. The FY 1988 request funds the continuation of analyses for the ISP, VANGUARD, and the field assessment teams, effectiveness modeling of multiple theater air bases, development of a methodology to optimize investments in ABO based on contributions to combat sortie generation, incorporation of the utility survivability model into the ABO models, publishing the ABO Integration Plan, initial operation of the ABO Data Center, and demonstration of Air Base Ground Defense detection equipment and procedures. The FY 1989 request funds the continued analyses that support the annual investment strategy planning process, VANGUARD, the utility survivability model, and other ABO models. Additionally, the continuation of the Field Assessment teams will require analysis support. The ABO Data Center and the ABO Integration plan will require significant support to keep information on each air base's survivability capabilities and overall ABO Planning objectives current. This level of effort project is expected to continue at least through FY 1992, continuing to integrate the many varied facets of ABO, providing modeling and analyses to assure our most critical needs are met and highest payoff areas are provided priority.

B. (U) Project: 3140, Camouflage, Concealment, and Deception (CCD). This project covers the full spectrum of CCD methods to mitigate the effectiveness of enemy attacks against airfields. The project includes advanced development work on decoys, obscuration concepts, and optical and electronic sensor deception. Using data from previous testing, demonstrations, and analyses, advanced development will be conducted on the most promising and appropriate technologies. Studies will continue to identify how different techniques affect vision or visual perception and identify the best technologies for that purpose. In FY 1986 some efforts transitioned out of advanced development. Tonedown (the use of paint, stain, and vegetation to reduce the visual signature of buildings and pavement) has been

proven effective and requires no further development. Air base commanders can use this technique now to reduce the highlighting of aircraft shelters, taxiways, and parking areas. Aircraft decoys will transition to full scale development in early FY 1987. Other efforts involve studies of radar deception by radar reflectors, light weight camouflage nets for unsheltered aircraft, and studies of employment capabilities for large area smoke screens (all transitioning in FY 1988). These are part of the first phase of CCD. The advanced CCD efforts (CCD Phase II) will begin in FY 1988 with a study to determine cost effective measures that will address electronic deception and deception of electronic sensors through passive means other than radar corner reflectors. This study will consider radio frequency, infrared, and ultraviolet sensor deception techniques. CCD Phase II will continue through FY 1990. As suitable techniques are identified in this advanced development effort, they will transition to full scale development. These transitions are expected to begin no earlier than FY 1990.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Cooperative work was authorized by a Memorandum of Agreement between the United States Government as represented by the United States Air Force and the Federal Republic of Germany as represented by the Federal Ministry of Defense. The memorandum, entitled "The Evaluation of Airfield Attack Submunitions and Air Base Recovery Techniques" was signed 18 December 1984. The cost of work under this memorandum was $180,000 in FY 1986. The effort yielded significant information on the capabilities of: a new German runway cratering munition, both countries' explosive ordnance disposal capabilities for this type of munition, and our runway repair capability when this type of munition is used. Work was completed in FY 1986 with additional efforts under discussion.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63320F — Title: Lower Cost Antiradiation Seekers
DOD Mission Area: 224 - Defense Suppression — Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		15,716	16,796	13,586	12,465	7,665	66,228

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Program Element is for advanced development of the High Speed Anti-Radiation Missile Low Cost Seeker (HARM). The increased sophistication, concentration, and lethality of enemy ground based, radar guided, missile and antiaircraft artillery systems threaten the ability of tactical aviation to accomplish its mission and survive. Anti-radiation missiles provide a lethal counter to this threat. The Tactical Air Forces require a system that enhances aircraft survivability during mission accomplishment. A variety of antiradiation weapon concepts are under consideration to accomplish this goal. The Lower Cost Seeker (LCS) is a US Navy derivative concept of the US Army Anti-Radiation Projectile design which provides an opportunity to meet HARM performance requirements. HARM is being acquired by the Navy and Air Force to meet an immediate need for an upgraded capability against current threats. The F-4G Wild Weasel represents the only dedicated lethal defense suppression weapon system in the Air Force inventory, HARM is its primary weapon. Other antiradiation weapons under consideration include short-range, low cost self-protection missiles for all tactical platforms.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	17,109	14,775	15,723	N/A	20,446	76,053

EXPLANATION: (U) FY 88 difference due to reduction in scope of program and contractor costs.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable. Procurement funding will be under separate system Program Elements (HARM: PE 27162F).

5. (U) RELATED ACTIVITIES: HARM, PE 27162F, has been designated as the primary antiradiation missile for the F-4G Wild Weasel. A Memorandum of Agreement of July 1975 between the Air Force and Navy Assistant Secretaries for Research and Development names the Navy as the Executive Service and the Air Force as the Participating Service in the Joint Service HARM Development Program. The F-4G APR-38 Radar Homing and Warning Receiver is optimized in Program Element 27136F, F-4G Wild Weasel Squadrons, to fully utilize HARM's capabilities. Navy resources for Lower Cost Seeker (LCS) development are in Program Element 63320N.

6. (U) WORK PERFORMED BY: The two primary contractors performing work for this program effort are Ford Aerospace and [illegible]ions Corporation, Newport Beach, CA, and Raytheon Company, Missile Systems Division, Lowell, MA. Air Force

program management is provided by Headquarters Air Force Systems Command, Andrews AFB, MD, and its subordinate organization, Armament Division, Eglin AFB, FL. Government facilities such as the Aeronautical Systems Division, Wright-Patterson AFB, OH; Naval Weapons Center, China Lake, CA; and the Air Force Flight Test Center, Edwards AFB, CA, are also utilized. Air Force participation in joint testing will be conducted by the Tactical Air Warfare Center, Eglin AFB, FL, and monitored by the Air Force Operational Test and Evaluation Center, Kirtland AFB, NM.

7. (U) PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 63320F, Lower Cost Anti-Radiation Seekers

A. (U) Project Description: This program supports the design and development of an alternate, directly replaceable, reduced-cost guidance section which meets the operational requirements of the baseline AGM-88 High Speed Anti-Radiation Missile (HARM). The HARM LCS program adapts technology derived from the Anti-Radiation Projectile (ARP) program and other advanced, passive, radio frequency (RF) guidance technologies to USN and USAF requirements for an anti-radiation guided missile, specifically HARM. ARP and RF technologies will be applied to the design of HARM antenna and receiver subassemblies (seeker). These technologies have potential for substantially reducing parts count, number of electrical connections, and design sensitivities. The resulting HARM guidance sections will exhibit greater reliability and enhanced producibility at reduced cost. The Air Force, as the Participating Service in the Joint Navy/Air Force Lower Cost Seeker (LCS) program, will fund those development efforts that are unique to the Air Force. The Air Force's emphasis is to integrate the LCS with the HARM and the F-4G. This integration requires the development and testing of computer software to certify the missile for carriage and launch from the aircraft, and ground/flight tests of the avionics/missile interface. Additionally, peculiar Air Force ground support equipment and technical manuals will be developed.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: The breadboard seeker design work was completed and the first Critical Design Review was accomplished in January 1986. Contractors initiated the brassboard design of the seeker and began building 12 prototype seekers (6 each) for test and downselection purposes.

(2) (U) FY 1987 Program: The brassboard models will be completed in December 1986 and undergo development testing. The twelve prototypes will undergo qualification testing and the second Critical Design Review will be performed in July 1987 to evaluate contractor designs and downselect to one design. This is equivalent to a Full Scale Development (FSD) decision.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The two contractors will spend this fiscal year by each manufacturing 20 production prototype model seekers based on the design selected at Critical Design Review 2. Delivery is scheduled for September 1988. Naval Weapons Center will begin concurrent

testing. Cost estimate for this program was developed by the Navy program office. The three estimating techniques used were Parametric Life Cycle Costs, comparisona between costs of the current HARM seeker and the lower Cost Seeker with adjustments for complexity, and the RDT&E II model. These costs are regarded as Category III, Budgetary, and the quality of data used are considered reliable. The Lower Cost Seeker program is in Full Scale Development. Estimates are based on the assumption of competition throughout the program. The latest comprehensive cost estimate was performed in June 1985.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: This fiscal year will see the continuation of DT&E and the beginning of IOT&E using the prototypes developed by the two contracting agencies.

(5) (U) Program to Completion: Production prototype model deliveries will be completed and testing (ground qualification, captive flight, and firings) will be accomplished in Fiscal Year 1989. Fabrication of the initial two hundred initial production items will begin in FY 1990 and be completed in FY 1991. Insertion in HARM production line will be accomplished.

C. (U) Major Milestones:

Milestones	Dates
(1) (U) Contracts Award	April 1985
(2) (U) Critical Design Review I	January 1986
(3) (U) Brassboard Models Complete	December 1986
(4) (U) Brassboard Development Testing	November 1986 - June 1987
(5) (U) Critical Design Review II (FSD)	July 1987
(6) (U) DT&E	December 1987 - October 1988
(7) (U) Production Prototype Units (40) Complete	September 1988
(8) (U) USAF IOT&E	October - November 1988
(9) (U) Engineering Change Proposal Approval	January 1989
(10) (U) OT&E	March - August 1989
(11) (U) USAF IOC	September 1992

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63714F
DOD Mission Area: 205 - Physical Security Systems

Title: DOD Physical Security Equipment-Exterior
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		4,916*	951	912	937	Continuing	N/A

*Includes 3,999 for the Technical On-Site Inspection Program (PE63717F).

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program supports the advanced development of the Department of Defense Base and Installation Security System, a standardized set of components, interfaces, and methodology for creation of exterior physical security systems, by accomplishing advanced development tasks in three functional areas: detection, command and control and imaging. A Department of Defense need exists for a family of standardized modular equipment which can be integrated into system configurations to provide a level of security in consonance with the deployment mode, threat level and sensitivity of the asset being protected. The resulting security equipment increases the capability of the security forces to detect and intercept terrorists and permits increased mobility of the forces for better utilization of existing manpower.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	985	984	931	N/A	Continuing	N/A
Other Procurement	33,380	0	11,883	N/A	-	-

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
Other Procurement (27589F)						
Funds	33,380	0	8,288	8,404	Continuing	N/A
(Spares funds not included)						
Quantities	Not Applicable					

EXPLANATION: FY 1987 Other Procurement funds reduction will delay by one year providing improved Security Systems for three USAFE bases.

5. (U) RELATED ACTIVITIES: Engineering Development tasks are accomplished under Program Element 64715F, Department of Defense Physical Security Equipment-Exterior (Engineering Development). Procurement of physical security equipment is accomplished using Other Procurement-Air Force funding under Program Element 27589F, Air Force Physical Security Systems. The Base and Installation Security System equipment will be designed for interoperability with the Army interior security system (facility intrusion detection system) and the Army tactical sensor system (remotely monitored

battlefield sensor system). Management oversight of the physical security equipment program is provided by the Department of Defense Physical Security Equipment Action Group with the Chairperson residing in the Office of the Under Secretary of Defense for Research and Engineering.

6. (U) WORK PERFORMED BY: This program is managed by the Physical Security Systems Directorate, Electronic Systems Division, Hanscom AFB, MA. Department of Defense agencies performing development tasks are: Rome Air Development Center, Griffiss AFB, NY; Army Mobility Equipment Research and Development Command and Army Night Vision Laboratory, Fort Belvoir, VA; Army Waterways Experimental Station, Vicksburg, MS; Naval Ocean Systems Center, San Diego, CA; and the Naval Coastal Systems Center, Panama City, FL. In addition to these Defense agencies, the Department of Energy/ Sandia National Laboratory, Albuquerque, NM performs development tasks, and Analytical Systems Engineering Corp. assists with systems engineering support and integration tasks. Contractors presently developing security systems under this effort include E-Systems, Fairfax, VA; Computing Devices Company, Ottawa, Canada; Magnavox Electronics Systems Company, Ft Wayne, ID; Teledyne Controls Corp., Los Angeles, CA; Sanders Assoc., Nashua, NH, and ISC Corp. Lancaster, PA.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 63714F, DOD Physical Security Equipment-Exterior

A. (U) Project Description: Continues advanced development of physical security systems with primary emphasis placed on sensors (detection), sensor processing techniques, and imaging subsystems. Advanced development projects include an infrared charged coupled device for sensor applications.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: The infrared charged coupled device, for sensor applications under no/low light conditions continued. Additionally, sensor signal processing techniques, and commercial sensor evaluation for use in Department of Defense (DOD) applications continued. Evaluation of various commercially available entry control devices for DOD entry control applications initiated.

(2) (U) FY 1987 Program: Development of the infrared charge coupled device and advanced signal processing technologies to improve sensor capabilites continued. Commercial sensor evaluation and entry control technologies were also be evaluated for DOD applications.

(3) (U) FY 1988 Planned Program and Basis For FY 1988 RDT&E Request: Development of the infrared charged coupled device will continue for sensor applications under no/low light conditions. Sensor signal processing techniques and commercial sensor evaluation for use in DOD applications will be continued. Evaluation of various entry control devices for DOD entry control applications will be continued. Category III, budgetary, cost estimate is [illegible] on inputs from various government agencies performing these development efforts. The cost estimate was updated [illegible]ember 1986.

Program Element: 63714F
DOD Mission Area: 205 - Physical Security Systems

Title: DOD Physical Security Equipment-Exterior
Budget Activity: 4 - Tactical Programs

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Evaluation of commercial products for use in DOD applications will be continued. Advanced Sensor space processing techniques will continue to be investigated and efforts will be initiated for advanced sensor concepts. A Category III, budgetary, cost estimate for this effort is based on inputs from various government agencies performing these development efforts. The estimate was updated September 1986.

(5) (U) Program to Completion: Efforts initiated in FY 1986 and earlier will be continued and transitioned to engineering development as appropriate. Development will be continued to provide security systems to protect Air Force resources commensurate with the required level of security and threat. This is a continuing program.

C. (U) Major Milestones: Not Applicable.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63742F **Title:** Combat Identification Technologies
DOD Mission Area: 344 - Tactical Command Control **Budget Activity:** 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	7,710	6,005	1,457	1,951	Continuing	N/A
1177	Noncooperative Identification Techniques *	2,265	0	0	0	N/A	N/A
2597	Noncooperative Identification Subsystems**	0	0	1,457	1,951	Continuing	N/A
2599	Cooperative Identification Techniques	5,445	6,005	0	0	N/A	N/A

* FY 1987 - 1989 funding for Project 1177 transferred to PE 63203F
** FY 1988 - 1989 funding for Project 2597 transferred from PE 64725F

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The purpose of this program element is to accomplish engineering development of systems that will provide reliable long-range identification of airborne targets in all-weather and hostile electromagnetic countermeasures environments. This program is necessary because the numerical superiority and increasing capability of the projected threat demands that we engage the enemy at long ranges with beyond visual range weapons. Long-range,

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	8,528	6,314	0	N/A	Continuing	N/A

EXPLANATION: (U) Reduction in FY 1986 due to directed reductions.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: Work accomplished under this program element is part of an integrated Tri-Service effort to improve United States identification capabilities worldwide. Related activities include: Program Element (PE) 63267N, NATO Future Identification System; PE 63515N, Advanced Identification Techniques; PE 63706A, Identification Friend or Foe (IFF) Developments; PE 64211N, Air Traffic Control Radar Beacon System/Mark XII; and PE 64709A, IFF Equipment. Coordination and integration of the various activities under these program elements are accomplished through the Air Force led Tri-Service, Combat Identification System Program.

6. (U) WORK PERFORMED BY: The overall program is managed by the Tri-Service, Combat Identification System Program Office (CISPO) at the Aeronautical Systems Division, Air Force Systems Command, Wright-Patterson AFB, OH. The Air Force, Wright Aeronautical Laboratories/Avionics Laboratory, Wright Patterson AFB, OH manages project 1177. Additionally, the following contractors are engaged in work under this program: Allied-Bendix Communications Division, Baltimore, MD; Veda Incorporated, Dayton, OH; Texas Instruments, Dallas, TX.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

Project: 2597, Noncooperative Identification Subsystems.

A. (U) Project Description: Beyond visual range identification (ID) of airborne targets is a critical requirement in the counter-air mission area. [

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B. Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Not Applicable.

(2) (U) FY 1987 Accomplishments: Not Applicable.

(3) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The funding level for FY 1988 is required to accomplish a joint USAF, Army and Navy effort to develop noncooperative ID techniques for applications

in air and ground tactical systems.

(4) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The level of effort in FY 1989 is a continuation of efforts started in FY 1988.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not Applicable.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63749F
DOD Mission Area: 372 - Escort, Standoff, and Counter C^3

Title: C^3 Countermeasures Advanced Systems
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	2,102	1,865	1,386	1,872	Continuing	N/A
2947	Advanced Countermeasures	2,102	0	0	0	N/A	N/A
3408	C^3CM Exploitation	0	0	0	0	0	0
3409	High Power Microwave	0	465	880	1,500	Continuing	N/A
3410	Battle Management	0	930	406	220	Continuing	N/A
3411	Electronic Deception	0	0	0	0	Continuing	N/A
3412	C^3 Jammers	0	470	100	152	Continuing	N/A

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Air Force combat operations can be significantly enhanced by With this capability, our commanders can This program provides advanced development and system feasibility demonstrations of promising new C^3 countermeasures technologies and techniques. Projects include: technology demonstrations to environment; development of weapons to destroy/degrade mobile command posts; improved C^3 countermeasure decision aids for battlefield commanders; advanced development and demonstration of techniques; and architecture development for C^3 countermeasures for use in the 1990's when enemy use of new technologies, such as, can be expected. This is part of a Science and Technology program.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	3,463	4,581	5,400	N/A	Continuing	N/A

EXPLANATION: (U) Congress reduced the FY 1987 request by $2.581 million and the Air Force reduced FY 1988 by $4.014 million to support higher priority requirements.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

Program Element: 63749F
DOD Mission Area: 372 - Escort, Standoff, and Counter C^3

Title: C^3 Countermeasure Advanced Systems
Budget Activity: 4 - Tactical Programs

5. (U) RELATED ACTIVITIES: This program was created to support countermeasures advanced developments and to accelerate their transition into full-scale development. Laboratory investigation to develop new C^3 countermeasures capabilities will be conducted in PE 63203F, Advanced Avionics for Aerospace Vehicles. Technology that satisfies similar requirements for other systems may be drawn upon, such as those in PE 62204F, Aerospace Avionics; and 62715F, Tactical Electronic Warfare Technology.

6. (U) WORK PERFORMED BY: The Electronic Systems Division of the Air Force Systems Command, Hanscom AFB, MA is responsible for management of this program. The MITRE Corporation, Bedford, MA, provides technical support to the program office. Rome Air Development Center is responsible for technical activities in the High Power Microwave, Electronic Deception and Battle Management projects.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. Project 3408 - C^3CM Exploitation. This task will include development of designs and prototypes for advance signal processors, capable of handling Emphasis will be on a flexible design that can be adapted to different platforms (i.e., both small and large aircraft) and be software programmable to cover changes in the threat environment. System modularity as well as reliability and maintainability will be included in the design. Major projects within this task will be generic signal processor (GSP) design and development, threat working group (TWG), and system applications. FY 1986 activities were conducted in project 2947 and limited to preparatory actions required to design a signal acquisition system. The project will be discontinued in FY 1987 due to the Congressional funding reduction.

B. Project 3409 - High Power Microwave. This project, as part of the Air Force High Power Microwave (HPM) Program, will investigate the potential application of The main thrust will be to determine the will be developed and tested. To support these activities, HPM radiation failure In addition physic research and analysis will be conducted, HPM test facilities and diagnostics will be improved and a standard test methodology will be developed and coordinated with other DOD HPM test organizations. In FY 1986 the program office continued investigations (study/lab experiments) under project 2947 to determine feasibility of Planned activities for 1987 include anechoic chamber testing of several communication systems and radios to be followed by high power field and range tests. A standard HPM test methodology will be developed, coordinated and documented. Plans for FY 1988 include continuation of the the development of and proof of reality demonstrations of HPM effects in field tests. The development of HPM C^3CM concepts will be initiated. Plans for FY 1989 include continued HPM testing and analysis of the effects on complex C^3 systems, further proof of reality field tests and the development of hardening standards for use by C^3 system program offices. At least six

Program Element: 63749F
DoD Mission Area: 372 - Escort, Standoff, and Counter C^3

Title: C^3 Countermeasures Advanced Systems
Budget: 4 - Tactical Programs

C. Project 3410 - Battle Management. This project develops and evaluates designs and processes to aid in the planning and execution of C^3CM activities. The efforts will include automated aids for the and assessment of frequency deconfliction requirements. These aids will be integrated with other battle staff planning functions. In FY 1986 efforts have started under project 2947 to develop and demonstrate an integrated mission which will optimize the employment of Compass Call, EF-111A and Wild Weasel planning system for the 65 Air Division in USAFE. In FY 1987 the definition of system operational requirements will be completed. Based on these requirements a strawman system concept and prototype system will be developed to be used in a concept demonstration at Green Flag in March 1987. Plans for FY 1988 include completion of the test and demonstration of the prototype with USAFE and the preparation of full system specification for system acquisition. In FY 1989 the full system specification for the USAFE integrated EC planning capability will be completed.

D. Project 3411 - Electronic Deception. This project will develop, demonstrate and evaluate The objective of these techniques will be to The objective of this project is to develop and demonstrate a comprehensive electronic deception capability using emerging deception technologies. Technologies include techniques as well as systems to deceive In 1986 preliminary efforts in electronic deception were conducted to include testing and specification development of denial and deception systems. In addition an analysis of the reaction of to potential decoy systems was intitiated as a precurser to the development of an experimental system to emulate high value airborne systems. In FY 1987 the analysis of will be completed. The concept of operation for a system and concept demonstration will be delayed until FY 1990 due to Congressional budget reductions.

E. Project 3412 - C^3 Jammers. The purpose of this project is to develop designs and engineering prototypes for special jammer applications. Initial efforts will focus on jamming and a screen jammer to protect FY 1986 efforts included the development and bench testing of two prototype in project 2947. Plans for FY 1987 include continued development of the and field testing of the prototype systems to verify their effectiveness. The SAC screen jammer effort will involve a review of system requirements, the calculation of important system parameters and acquisition of receiver transmitter and processor components. The hardware will be assembled and integrated into a vehicle for demonstration of key system sensor/jammer characteristics. Plans for FY 1988 include completion of the jammer test analysis and the development of system specifications for Full Scale Development. The SAC screen jammer will be demonstrated in field exercises and system specification for Full Scale Development will be prepared. Plans for FY 1989 include the start of strategic C^3 jamming system design and development.

8. (U) PROJECTS OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64201F
DOD Mission Area: 223 - Close Air Support and Interdiction

Title: Aircraft Avionics Equipment Development
Budget Activity: 4 - Tactical

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	23,742	21,907	19,685	22,648	Continuing	N/A
2257	Standard Avionics and Joint Services Review Committee (JSRC) Initiatives	2,600	3,420	3,263	5,114	Continuing	N/A
2258	Standard Inertial Navigation Unit	7,720	5,273	2,700	3,000	Continuing	N/A
2297	Embedded Computer Software Standardization	2,626	2,600	2,300	2,300	Continuing	N/A
2519	Airborne Radar Improvements	6,320	5,300	5,124	5,534	Continuing	N/A
2560	JOVIAL Language Control Facility	938	1,000	800	800	Continuing	N/A
2590	Mission Planning Calculator System	757	0	0	0	0	1,657
2658	Avionics Architecture Implementation and Support	906	1,000	1,000	1,500	Continuing	N/A
2993	Digital Audio Distribution System (DADS)	190	0	0	0	0	3,490
3264	Standard Flight Data Recorder (SFDR)	685	1,100	4,500	4,400	7,330	18,015
3401	Ground Collision Avoidance System (GCAS)	1,000	2,214	0	0	0	6,300

Program Element: 64201F
DoD Mission Area: 223 - Close Air Support and Interdiction

Title: Aircraft Avionics Equipment Development
Budget Activity: 4 - Tactical Programs

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element develops standard avionics architectures and equipment to reduce support costs and allow technology evolution to provide operational force improvements. Joint avionics development efforts are pursued through participation in and support of the Joint Services Review Committee (JSRC). Current JSRC initiatives undergoing development at this time include a Ground Collision Avoidance System and a Standard Flight Data Recorder. This program also supports generic radar applications to improve performance, reliability and maintainability of current Air Force airborne fire control radars. Finally, this program funds necessary ongoing support activities to ensure a credible avionics standardization program is maintained.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
RDT&E	28,383	25,092	23,935	N/A	Continuing	N/A

EXPLANATION: (U) FY 1986 and 1987 reductions are a result of FY 87 Congressional actions and general Air Force budget reductions. FY 1988 reduction reprogrammed by Air Force for higher priority programs.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: This program is closely coordinated with the Army and Navy to maximize joint developments where feasible. Multiservice initiatives are supported through participation in the Joint Services Review Committee. In addition, a Tri-Service memorandum of agreement has been established to promote interservice standardization. A Standard Flight Data Recorder and Ground Collision Avoidance System are being developed jointly with the Navy and Army. There is a close relationship between the products of this program and the technological building blocks developed in advanced and exploratory development programs such as PE 63203F, Advanced Avionics for Aircraft; PE 63253F, Advanced Systems Integration Demonstration; and PE 62204F, Aerospace Avionics. Techniques, components and subsystems showing high payoff potential can be progressively transitioned through the development process until a specific weapon system application is identified and an engineering development task established. The Airborne Radar Improvements project investigates the generic radar improvements possible with initial application in the F-15, F-16, and B-1B. For example, radar electronic counter-countermeasures test data obtained from PE 63750F, Counter/Countermeasures Advanced Development, will aid in developing software for this project.

6. (U) WORK PERFORMED BY: Program management is provided through Air Force Systems Command by the Aeronautical Systems Division, Wright-Patterson AFB, OH. Major contracts of Project 2257 are with the Analytic Sciences Corporation, Reading, MA; Oneida Resources, Inc., Dayton, OH; and Aeronautical Radio Inc., Annapolis, MD. Project 2258 is currently contracted to Honeywell Corporation, Clearwater, FL, Litton Systems, Inc., Woodland Hills, CA, and Singer

Kearfott Corporation, Little Falls, NJ. The Project 2297 contractor is Proprietary Software Systems, Santa Monica, CA. Project 2519 is contracted with Hughes Aircraft Corporation, Culver City, CA, Westinghouse Electric Corporation, Baltimore, MD., and Support Systems Associates, Inc., Dayton, OH. The project 2560 contractor is SOFTECH Inc., Waltham, MA. Project 2590 is under contract to Horizon Technology, Inc., San Diego, CA. Project 3401 contractor is Cubic Corporation, San Diego, CA.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 2257, Standard Avionics and Joint Services Review Committee (JSRC) Initiatives. This project assists the Deputy for Avionics Control, Aeronautical Systems Division, with identification and assessment of systems and subsystems to be developed and/or designated as Air Force standard items through interface with Air Force Systems Command (AFSC), Air Force Logistics Command (AFLC), and the operational Major Commands (MAJCOMs). It evaluates the standardization potential of candidate systems and, when necessary, initiates hardware development. It also develops specifications and standards for systems/subsystems that have been approved for standardization. Coordination with appropriate services is accomplished through participation in and support of the JSRC. During FY 1986, a supportability study was conducted to determine the feasibility of developing a standard compass system to replace aging, obsolete, unreliable gyrocompass navigation systems currently in the Air Force inventory. Efforts to develop a Tri-Service Next Generation Avionics Computer standard were initiated. Also, development of a Modular Avionics Systems Architecture (MASA) and initial planning for full scale development (FSD) of Line Replaceable Modules (LRMs) and supporting architectures began. During FY 1987, a Tri-Service specification will be written, coordinated, and published defining the Standard New Technology Compass System. Based on the degree of acceptance of this specification, development and/or acquisition of Standard Compasses will be initiated. Efforts to develop a Tri-Service Next Generation Avionics Computer MIL-STD will continue as will efforts related to MASA and LRM full scale development transition. During FY 1988, development, acquisition, testing, and installation of Standard Compasses will take place. Development of the Tri-Service Next Generation Avionics Computer MIL-STD will continue as will MASA/LRM FSD planning. An initial evaluation will be made to determine the feasibility of, and assess alternative approaches to, developing a Standard Data Transfer Unit for single port entry of aircraft mission data. During FY 1989, MASA/LRM FSD planning should be essentially completed with smooth transition to initial FSD occurring. In addition, evaluation of single port Standard Data Transfer Unit alternatives will be completed and an approach selected and pursued. During FY 1990 and beyond this ongoing project will continue providing the front-end activity needed to determine the feasibility of standardizing selected avionics systems/subsystems identified through the Air Force and Joint Service avionics planning process. Support of JSRC initiatives will continue with development of the Tri-Service Next Generation Computer architecture MIL-STD and the Standard Data Transfer System.

B. (U) Project: 2258, Standard Inertial Navigation Unit (INU). This project upgrades the Air Force's Standard Form, Fit, Function (F^3) and F-15 Medium Accuracy (0.6 nm/hr) INUs by incorporating ring laser gyro (RLG) technology to provide significant improvements in reliability and maintainability. In addition, this effort also funds development efforts related to incorporation of a Precision Accuracy (0.2 nm/hr) INU. The F^3 INU program consists of a demonstration portion to show that no degradation of navigation accuracy occurs in a vigorous military aircraft

environment, and a qualification portion where inertial navigation unit (INU) manufacturers are required to submit their respective systems for testing to ensure compliance with the Standard F^3 INU specification (SNU 84-1). F^3 INU development is funded by each contractor while the Air Force funds all demonstration/acquisition testing costs at the Air Force's Central Inertial Guidance Test Facility (CIGTF). Initial applications are targeted to the F-4, F/EF-111A/E, A-7, C-130, C-17, HH-53, and OV-10 aircraft. The F-15 Ring Laser Gyro (RLG) Inertial Navigation Unit (INU) program includes development and certification of multiple sources for the F-15E and F-15 A-D retrofit programs. The Precision Accuracy INU program includes certification of a Standard Form, Fit, Function (F^3) Precision Accuracy INU for Special Mission C-130 (Combat Talon I and II) and AC-130 Gunship aircraft. In FY 1986, F-15 RLG INU development continued. During FY 1987, both F^3 and F-15 RLG INU flight demonstrations/verifications will be conducted. In addition, F^3 RLG INU transparency demonstrations will be performed to demonstrate the ability of the F^3 INU units to be used on multiple aircraft types with no hardware retrofit required. CIGTF qualification testing of Precision Accuracy RLG INUs will commence. Specification development for a Fault Tolerant Inertial Reference Assembly (IRA) will also start. During FY 1988, Precision Accuracy RLG INU qualification testing will be completed. The IRA specification will be completed and full scale development (FSD) started. During FY 1989 and beyond, this ongoing program will continue to update the Standard INU to allow incorporation of new technologies such as Very High Speed Integrated Circuits (VHSIC), Fiber Optics and other new technology gyros, etc. In addition, IRA FSD and certification will be completed.

C. (U) Project: 2297, Embedded Computer Software Standardization. This project supports and maintains the Embedded Computer Standardization Program Office (ECSPO) within the Air Force's Deputy for Avionics Control. The ECSPO provides Air Force weapon systems programs with timely, high quality JOVIAL J-73 (MIL-STD-1589) compilers, and associated MIL-STD-1750A 16-bit Computer Instruction Set Architecture (ISA) support software, such as assemblers, linkers, debuggers, and simulators. During FY 1986, support of JOVIAL and MIL-STD-1750A software support tool problem report/corrections continued. Also development of a production quality Ada (ANSI/MIL-STD-1815A) compiler targeted to MIL-STD-1750A was initiated based on earlier AFWAL work in this area. During FY 1987, release of version 4.0 of the Integrated Tool Set will be made. Also, development of the Ada to MIL-STD-1750A compiler will be completed and development of optional enhancements to the compiler begun. JOVIAL and MIL-STD-1750A software support tool work will continue. During FY 1988, development of enhancements to the Ada to MIL-STD-1750A compiler will be completed and released. Support of JOVIAL and MIL-STD-1750A software support tools will continue. During FY 1989 and beyond, ongoing support to the Ada to MIL-STD-1750A compiler will continue as will support of JOVIAL and MIL-STD-1750A software support tools for the over 300 ECSPO users currently being supported.

D. (U) Project: 2519, Airborne Radar Improvements. This project supports development of generic radar improvements for current Air Force airborne fire control radar systems. Emphasis is on improving reliability and maintainability (R&M) and developing common mode capabilities among the F-15, F-16 and B-1B radar systems with minimum duplication of effort. In addition, this project supports coordinated radar development between the Air Force laboratories, aircraft system program offices, contractors, and other users. During FY 1986 electronic counter-countermeasures (ECCM) technology baseline transition continued with development of an ECCM threat data base in coordination with the Air Force's ECCM Master Plan. As part of the F-15/F-16 Reliability and Maintainability (R&M) Improvement program, development of reliability and maintainability fixes for the APG-63/66 radars continued with F-15 Built-in Test (BIT)

improvements and a Coolenol contamination investigation. An F-15 Redar Roadmap wes completed as part of a comprehensive Airborne Radar Roadmap that is being developed. Also development of an F-15 Radar Reliebility and Maintainability (R&M) History Tracking system (Phase I) was initiated. Finally, support for the development of the Advanced Radar Testbed (ARTB) continued with the start of test aircraft nose modifications to accommodate radar test assets. During FY 1987 electronic counter-countermeasures (ECCM) technology baseline transition will continue with emphasis on ECCM applications. Radar Roadmap development efforts will include initiation of F-16 and B-1B Radar Roadmaps. F-15 Radar R&M History Tracking (Phase I) system development will be completed and Phase II initiated. F-15 Radar Built-In Test (BIT) improvement and Coolanol contamination investigations will continue. During FY 1988 development of F-15 BIT improvements will be completed. Radar R&M History Tracking (Phase II) will be completed. ARTB modification and fabrication will be completed and integration into a C-141 test aircraft will begin. F-16 and B-1B Radar Roadmaps will be completed. Finally, ECCM technology baseline transition will continue with transition of Simultaneous Transmit and Receive (STAR) technology into full scale development. During FY 1989 ARTB instrumentation software design will be completed and integration and installation into a C-141 test aircraft completed. The Coolanol Contamination investigation will be completed. Updates of F-15, F-16, and B-1B Radar Roedmeps will be accomplished. During FY 1990 and beyond, this program will continue to explore new radar technologies for transition to full scale development. ECCM technology baseline transition activities will continue and updates to the F-15, F-16, and B-1B Radar Roadmaps will be provided on an annual basis.

E. (U) Project: 2560, JOVIAL Language Control Facility (LCF). This project supports the JOVIAL Languege Control Facility (LCF), a service organization established by the language control agent to ensure the stability and configuration of the JOVIAL language (MIL-STD-1589C). The LCF provides control and maintenance of standerd langusge definitions, control of software support tools, and compiler validation testing. In addition, the LCF provides both government and industry users advice and assistance in using and implementing JOVIAL. It is estimated that under full operation the JOVIAL LCF saves the Air Force $15 million a year in compiler acquisition costs alone. During FY 1986, the LCF validated 20 compilers for compliance with the MIL-STD, participated in 3 JOVIAL/Ade Users Group meetings, conducted 6 JOVIAL training classes for some 100 personnel, and published the JOVIAL LCF Newsletter. In FY 1987 the JOVIAL LCF will continue to resolve JOVIAL language issues. During this period the LCF expects to validete approximately 15-20 compilers, support at least 3 users group meetings, and conduct 6 JOVIAL training classes. Publication of the JOVIAL LCF Newsletter will also continue. During FY 1988 and FY 1989, efforts to maintain end control MIL-STD-1589C will continue. All new JOVIAL compilers will be validated for conformence to this stenderd. Treining end participation in government/industry forums will also continue. Approximately 10-15 compilers ere expected to be validated, 3 JOVIAL Users Group meetings supported, and 6 JOVIAL training classes conducted. Initial efforts at defining MIL-STD-1589D will also begin. Beyond FY 1989 this ongoing program will continue to velidete new JOVIAL compilers while maintaining and controlling the JOVIAL High-Order Languege.

F. (U) Project: 2658, Avionics Architecture Implementation end Support (AAIS). This project supports the Systems Engineering Avionics Facility which provides for the development and support of evionics architecturel stenderds such as the MIL-STD-1553B Multiplex Data Bus, MIL-STD-1750A 16-Bit Computer Instruction Set Architecture and MIL-STD-1760 Aircraft/Stores Electricel Interconnection System. It cerries out necessary validation testing end

provides consultation and engineering support for development and support of new and existing avionics architectural standards. Applicable new technologies are also investigated and appropriate new standards developed as required. During FY 1986 validation/verification of implementations of MIL-STD-1553B (32 Systems) and MIL-STD-1750A (16 Systems) were performed. In January of 1987, an 18 month contract to update the MIL- STD-1553B Handbook will be awarded. Responsibility for developing the MIL-STD-1760 Aircraft/Stores Electrical Interconnection System continued. During FY 1987, MIL-STD-1553B and 1750A verification/validation activity will continue (26 MIL-STD-1553B and 18 MIL-STD-1750A validations are projected for FY 1987 and 1988). MIL-STD-1760 development will continue. During FY 1988 this ongoing support program will continue to certify avionics compliance with MIL-STDs- 1553B and 1750A. In addition, a development effort will begin for MIL-STD-1750 and MIL-STD-1760 Handbooks. For FY 1989 and beyond, verification/validation of avionics systems for MIL-STD-1553 and 1750 compliance will continue. Development of a validation capability for a High Speed Data Bus (HSDB) and other futura avionics architectural standards will be initiated and the MIL-STD-1760 Handbook will be completed and distributed. In addition, a development effort will begin for a 32/64 bit avionics computer architectural standard.

G. (U) Project: 3264, Standard Flight Data Recorder (SFDR). This project provides for development of a crash survivable SFDR to replace current Aircraft Structural Integrity Program (ASIP) flight structures recorders currently in use and to provide the capability for recording crash incidence data. The SFDR is a Joint Services Review Committee (JSRC) sponsored initiative that capitalizes on development pursued within the F-16 program office using a Tri-Service coordinated exhibit. Currently the system is configured with a signal acquisition unit for processing and recording flight structures and other information, and an optional crash survivable memory unit, used to provide crash incidence data following a mishap. During FY 1986 development of amendments to the F-16 SFDR specification were initiated for F-15 and C-17 aircraft. In FY 1987, a full scale development contract will be awarded for SFDR trial installation units for sixteen Air Force production and retrofit aircraft. During FY 1988 and FY 1989, SFDR development will continue for near term applications on F-15E, C-17 and C-130 aircraft and application to Air Force Logistics Command's ASIP flight recorded retofit program.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64212F
DOD Mission Area: 225 - Air Warfare Support

Title: Aircraft Equipment Development
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	6,064	4,700	1,939	2,139	Continuing	N/A
1926	Aircraft Windshield Development	2,665	2,565	1,939	2,139	Continuing	N/A
2098	Aircraft Accessories Development	2,820	1,778	0	0	0	6,623
2377	Airdrop Systems Support	240	357	0	0	Continuing	N/A
2709	Integrated Turbine Engine Monitoring System	180	0	0	0	0	2,291
4366	Integrated Attack Avionics	159	0	0	0	0	2,893

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Air Force updates its aircraft due to changing threats, equipment obsolescence and technical advancements, and to improve safety, efficiency, and effectiveness of operational aircraft. This program element develops, tests and evaluates aircraft subsystem equipment to satisfy these operational needs. Technological advances in aircraft equipment are exploited and translated into operational hardware. This is the only engineering development program element which utilizes advanced state of the art technology to develop windshield systems with improved hazard resistance and reduced cost of ownership.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	8,516	4,862	7,780	N/A	Continuing	N/A

EXPLANATION: The reductions reflect revised fiscal guidance and redirection of funds to higher priority programs.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: The following program elements relate to this program element: 41115F, C-130 Squadrons; 41118F, C-141 Squadrons; 62201F, Aerospace Flight Dynamics; 63203F, Advanced Avionics for Aircraft; 63211F, Aerospace

Structural Materials; 64201F, Aircraft Avionics Equipment; 64226F, B-1B; and 78026F, Productivity, Reliability, Availability and Maintainability. The Air Force works jointly with sister services in the development of airdrop systems.

6. (U) WORK PERFORMED BY: The contractors are: Pittsburgh Plate Glass Co., Huntsville, AL (1926); University of Dayton Research Institute, Dayton, OH (1926); Gila Bend Indian Reservation, Gila Bend, AZ (2098); and Ver-Val Corporation, Fort Walton Beach, FL (2377). The program manager is Aeronautical Systems Division, Wright-Patterson Air Force Base, Dayton, OH.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 1926, Aircraft Windshield Development.

A. (U) Project Description: This project applies the latest aircraft windshield technology to improve birdstrike resistance at high speed, while maintaining high optical quality, durability, minimum weight and low life cycle cost. The threat of birdstrike is continuing to grow because of more low altitude, high speed missions, thus increasing the risk of birdstrike.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Initiated the following: development test and evaluation (DT&E) of A-7 composite material arch and one piece windshield which provides resistance to an impact of a four pound bird at an aircraft speed of 480 knots (vice current 155 knots); operational test and evaluation (OT&E) of metallic coated F-111 transparencies, of F/RF-4 single piece windshield that provides four pound bird, 500 knot (vice current 190 knot) resistance, and of T-38 windshield system that provides four pound bird, 400 knot (vice current 200 knot) resistance.

(2) (U) FY 1987 Program: Complete DT&E of A-7 windshield. Continue OT&E of F-111 transparencies, F/RF-4 single piece windshield, and T-38 windshield system. Initiate DT&E of improved F-16 canopy that is intended to provide four pound bird, 500 knot (vice current 350 knot) resistance and OT&E of A-7 windshield, and development of improved B-1B windshield to improve optics, durability and cost.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Complete DT&E of improved F-16 canopy, OT&E of F-111 transparencies and T-38 windshield system. Continue OT&E of A-7 windshield and F/RF-4 single piece windshield, and DT&E of F-16 canopy. Initiate DT&E of improved B-1B windshield.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Complete OT&E of A-7 windshield and F/RF-4 single piece windshield. Continue DT&E of B-1B windshield and of F-16 canopy.

(5) (U) Program to Completion: This is a continuing program.

Program Element: 64212F
DOD Mission Area: 225 - Air Warfare Support

Title: Aircraft Equipment Development
Budget Activity: 4 - Tactical Programs

C. (U) Major Milestones: Not Applicable.

8. (U) PROJECTS OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64218F
DOD Mission Area: 225 - Air Warfare Support

Title: Engine Model Derivative Program (EMDP)
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		55,886	61,941	979	982	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Engine Model Derivetive Program (EMDP) is an engineering development program established to provide existing air vehicle systems with the latest edvances in engine technology and to provide a framework for engine development for future systeme. EMDP contributes to system life extension, reduced life cycle cost and enhanced performance characteristics to counter increases in system weight and/or increased threat capability. EMDP demonstratee derivative engine concepts that incorporate proven technology and advanced componente from government funded programs and contractor Independent Research and Development. EMDP emphasizes the demonstration of improvements in performance, durability and operability with additional payoffs in supportability, reliability and maintainability and other unique capabilities such as thrust reversing/vectoring nozzles in prototype enginee prior to full scele development. In addition, EMDP will demonstrate alternate engine candidetes to provide competitive engine opportunitiee for selected military aircraft systems. Candidates for competition may be commercial or military enginee currently in production ae well as commercial or militery engines currently in development end not yet qualified.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	60,606	68,132	3,156	N/A	Continuing	N/A

EXPLANATION: (U) FY 1986 funding reductions resulted from a Secretary of the Air Force decision for a reduced scope program for increased performance F100 and F110 engines for F-15s and F-16s and from a decision not to pursue a J402 Harpoon missile EMDP. FY 1987 was decreased as a result of Congressional reductions. The reduction in FY 1988 reflects a reallocation for higher priority programs.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: EMDP draws requisite technology from the following programs: PE 62203F, Aerospace Propulsion (advanced component technology); PE 63202F, Aircraft Propulsion Subsystem Integration (fan, low pressure turbine and limited engine test data); PE 63216F, Advanced Turbine Engine Gas Generator (high pressure compressor, combustor and high pressure turbine); and PE 78011F, Industrial Preparedness Program (materials processing and component fabrication demonstration). Activities from the Navy, the National Aeronautics and Space Administration, the Army and propulsion industry in-house programs also constitute significant sources of technology. The Air Force and the Navy

have a memorandum of understanding for joint cooperative propulsion programs in areas of common interest. PE 64268F, the Aircraft Engine Component Improvement Program (CIP) efforts directed toward engine flight safety problems, service revealed deficiencies and the achievement of durability goals also complement the long-term EMDP development process.

6. (U) WORK PERFORMED BY: The program is managed by the Aeronautical Systems Division, Deputy for Propulsion, Wright-Patterson AFB, OH. Altitude testing is conducted at the Arnold Engineering Development Center, Tullahoma, TN. The contractors currently involved are: Pratt and Whitney, Government Products Division, West Palm Beach, FL (F100 engine); the General Electric Company, Evendale, OH (F110 engine); and Williams International, Walled Lake, MI (FJ44 engine).

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: PE 64218F, Engine Model Derivative Program (EMDP)

A. (U) Project Description: EMDP provides capability which, when combined with new engine developments, will ensure that the Air Force has propulsion alternatives for both near-term and far-term needs. The only other means today of providing this capability is through full scale weapon system development. EMDP will conduct the early engineering development leading to a prototype derivative of an existing engine. Early demonstration of improved engine characteristics (i.e., performance, operability, durability, reliability and maintainability) reduces risk and shortens the time needed to fully develop and qualify an engine, thus providing a more immediate response to potential weapon system needs. Full scale development would be a separate program after validation of a requirement for increased weapon system performance. Specific tasks in the current EMDP are as follows (Note: Items (1), (2) and (3) are an integral part of the Tactical Fighter Roadmap plans for higher performance engines to be qualified in CY 1988 for installation in F-15 and F-16 aircraft delivered in CY 1990.) (1) F100 EMDP - Demonstrate an increased performance F100 engine having 4,000 total accumulated cycles durability as well as improved operability, reliability, maintainability and reduced life cycle cost. This engine configuration consists of the Improved Life Core developed in CIP, an increased air flow fan, an advanced augmentor and an improved low pressure turbine (LPT). (2) F100 Increased Performance - Demonstrate a higher thrust F100 engine having Alternate Fighter Engine levels of durability, operability, reliability and maintainability. The planned engine configuration includes an increased efficiency compressor and floatwall combustor, plus the fan, augmentor and LPT from the F100 EMDP described above. (3) F110 Increased Performance - Demonstrate a higher thrust F110 engine having Alternate Fighter Engine levels of durability, operability, reliability and maintainability. The planned engine configuration includes a digital engine control, upgraded core and LPT to run at higher combustion temperatures. (4) EMDP Initiatives - With funds available in FY 1988 through FY 1990, studies of chemical and biological warfare agents effects on engines, low-observables capabilities and engine applications (re-engining possibilities, competition opportunities) will be accomplished. Other initiatives planned include several demonstration efforts. These demonstrations include an advanced propfan engine for airlift application in the late CY 1990 time frame, an unducted fan or propfan engine concept for cruise missiles, low observables technology for cruise missile engines, a competitive tanker/transport engine, a two dimensional nozzle for the F101/B-1B engine, and an

afterburning TF41 engine with potential application in close air support aircraft. Also included is a continuing demonstration of a possible competitor for trainer aircraft engines, the Williams FJ44 engine. Other initiatives may begin as they are identified by the planning process.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: (a) F100 EMDP - completed 4000 cycle accelerated mission test. (b) F100 Increased Performance - completed detailed design and hardware procurement. Component testing accomplished. (c) F110 Increased Performance - Detail design and hardware procurement completed. Digital engine control development and testing continued. Component development testing conducted. Augmentor development tests conducted.

(2) (U) FY 1987 Program: F100/F110 Increased Performance - Complete Increased Performance tasks for both engines, including sea level testing, altitude testing at Arnold Engineering Development Center, and a 4000-cycle test. New Initiatives - Initiate analysis of engine observables and susceptibility to chemical and biological warfare agents. Altitude demonstration of the Williams FJ44 engine at AEDC will be accomplished. A preliminary study of the International Aero Engines (IAE) V2500 for KC-135 application/competition will be performed.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: New Initiatives - Preliminary design of advanced components and initial testing will begin to verify low observables (LO),chemical and biological analysis.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: New Initiatives - Component testing will continue to verify LO and chemical and biological analysis.

(5) (U) Program to Completion: EMDP is a continuing effort. The level of funding for EMDP is derived from bottoms-up estimates to conduct the demonstrations and objectives for each EMDP effort. These estimates are reviewed by technical and management specialists at Aeronautical Systems Division.

C. (U) Major Milestones:

	Milestones		Date
(1) (U)	F100 EMDP		
	4000 Cycle Accelerated Mission Test Complete		December 1986
(2) (U)	F100 IPE		
	Contract Award, Phase II, III	*(February 1986)	May 1986
	Demonstration Engine Testing Complete		August 1987

* Dates presented in FY 1987 Descriptive Summary

	Milestones (Continued)		Date
(3) (U)	F110 IPE		
	Contract Award, Phase II, III	*(February 1986)	July 1986
	Demonstration Engine Testing Complete		August 1987
(4) (U)	FJ44 AEDC test		February 1987
	V2500/KC-135 Study		March 1987

* Dates presented in FY 1987 Descriptive Summary

(U) EXPLANATION OF MILESTONE CHANGES

(2) and (3) (U) Changes in F100/F110 IPE Phase II and III contract award are due to additional time required to negotiate technical issues associated with the development program.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64219F | Title: Integrated Digital Avionics
DOD Mission Area: 223 - Close Air Support and Interdiction | Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	7,455	7,051	270	653	0	15,429
3144	Night Adverse Weather Avionics	6,000	7,051	270	653	0	13,974
3355	HH-53 Enhanced	1,455	0	0	0	0	1,455

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Air Force Special Operations Forces (SOF) aircraft such as the HH-53 and CV-22 require specialized avionics systems in order to perform long range penetration missions at night and in adverse weather. This program complies with Congressional direction to ensure development and modification of SOF HH-53s and CV-22s in order to meet the Joint Special Operations Command (JSOC) and unified commanders-in-chief's requirements within the FY 1986 five year development plan. Specifically, this effort develops the integrated avionics suite for the HH-53 and the multimode radar (MMR) for the CV-22. The MMR is essential for terrain following and terrain avoidance flight. The initial thrust of this program provided RDT&E funding to complete the Congressionally directed modification of HH-53s for SOF. The program also continued efforts previously funded in program elements 64753F and 63203F to develop a multimode derivative of the Low Altitude Navigation Targeting Infrared System for Night (LANTIRN) radar. The effort was then expanded to include development of an improved avionics suite for the CV-22, giving that aircraft the capability for night/adverse weather operations.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	8,000	13,394	276	N/A	0	23,885

EXPLANATION: (U) The differences in FY 1986 and 1987 are due to Congressional actions (including undistributed reductions). The difference in FY 1988 is due to a change in inflation.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable

5. (U) RELATED ACTIVITIES: MMR development was intitiated in program element 64753F (Combat Helicopter Modernization). When that program was restructured in FY 1984, MMR development was temporarily moved to program element 63203F (Advanced Avionics for Aircraft) for continuation as a generic effort. The Air Force and Navy versions of the V-22 (program elements 63256F and 64262N) both require MMR.

Program Element: 64219F — Title: Integrated Digital Avionics
DOD Mission Area: 223 - Close Air Support and Interdiction — Budget Activity: 4 - Tactical Programs

6. (U) WORK PERFORMED BY: The Air Force management of the multimode radar (MMR) program is accomplished by the Air Force Systems Command Aeronautical Systems Division, Wright-Patterson AFB, Ohio. The development contract for the MMR effort has been awarded to International Business Machines, Federal Systems Division, Owego, NY. Air Force management of the HH-53 program is accomplished by Air Force Logistics Command Warner-Robins Air Logistics Center, Robins AFB, GA, and installation will be done by Pensacola Naval Air Rework Facility, Pensacola Naval Air Station, FL.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3144, Night Adverse Weather Avionics

A. (U) Project Description: The MMR project will expand the capability of the Low Altitude Navigation Targeting Infrared System for Night (LANTIRN) radar. Terrain avoidance, ground map, air-to-ground ranging, beacon, and weather modes will be added to the radar to enable the CV-22 to fly low level at night and in adverse weather conditions. The project conducted initial flight test of the radar on the HH-60 test bed and will then develop software and hardware changes required for direct application on the V-22 for Navy combat rescue and Air Force special operations.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Activities included completion of lab testing and start and completion of preliminary flight testing on the HH-60 test bed at Edwards AFB, CA.

(2) (U) FY 1987 Program: The MMR effort is scheduled to be put into the Navy's V-22 contract and provided as contractor furnished equipment. Ground map, air-to-ground ranging, beacon, and weather modes will be added to the terrain following/terrain avoidance MMR. Physical changes to the MMR will be made to integrate it into the Air Force an Navy V-22s. Fabrication of the enhanced MMR and integrated logistics support will be completed.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Funding is for engineering change orders and flight tests needed to make this radar ready for V-22 incorporation. Cost data is considered mature (Category II) and is based on firm fixed price contractor proposals.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: FY 1989 funds are needed to prepare the radar for flight testing in the V-22 in FY 1990. The Navy will fund the actual flight test of the MMR.

(5) (U) Program to Completion: Not Applicable

Program Element: 64219F
DOD Mission Area: 223 - Close Air Support and Interdiction

Title: Integrated Digital Avionics
Budget Activity: 4 - Tactical Programs

C. (U) Major Milestones:

	Milestones	Dates
(1)	(U) Multimode Radar (MMR) development initiated (PE 64753F)	October 1982
(2)	(U) MMR Critical Design Review	June 1983
(3)	(U) Dedicated MMR flight test begins	April 1986
(4)	(U) MMR flight test completed	December 1986
(5)	(U) Start modification of MMR for CV-22	January 1987
(6)	(U) Hardware delivered to V-22 contractor	May 1988

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64220F Title: EW Counter Response
DOD Mission Area: 372 - Escort, Stand-off & Counter C^3 Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		31,152	26,100	13,654	2,634	Continuing	N/A
2066	EF-111A Upgrade	31,152	26,100	13,654	2,634	Continuing	N/A

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The EF-111A Tactical Jamming System provides tactical jamming of early warning, acquisition, and ground control intercept radars in support of United States and Allied tactical strike aircraft operations. It denies hostile command and control nets the input from surveillance radars forcing hostile fire control systems into autonomous and less optimum modes of operation; reducing their efficiency and effectiveness. The EF-111A Tactical Jamming System is an essential element of the tactical defense suppression "mix" of electronic combat support assets. The EF-111A provides the

By denying acquisition range, azimuth, and altitude information required by surface-to-air missiles (SAMs), anti-aircraft artillery (AAA) and airborne interceptors (AI), the EF-111A effectively degrades enemy defensive capabilities and provides necessary support jamming to United States Air Force tactical fighters and the

This program provides the research, development, test, evaluation and integration of software and hardware updates to aircraft electronic countermeasures subsystems to maintain system currency with the evolving and predicted threats.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	29,202	34,068	4,041	N/A	Continuing	N/A
Aircraft Procurement	0	0	60,700	N/A	Continuing	152,300

EXPLANATION: (U) FY 1986 RDT&E funding increased following program delays. FY 1987 Congressional reduction against PE of $7.1 million plus a general reduction of $.768 million. Funding added to FY 1988 to properly fund R&D tasks due to program restructure and previous cuts. No content changes.

4. (U) **OTHER APPROPRIATION FUNDS: ($ in thousands)**

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Aircraft Procurement/PE 27252F						
Funds	0	0	0	26,400	124,800	151,200
Quantities				2	36	(38)

5. (U) **RELATED ACTIVITIES:** Program Element 27252F, EF-111A Squadrons, funds the Class V modification kit procurement and military construction associated with the EF-111A Tactical Jamming System. This program element also procures the second Operational Flight Trainer, which will be located at RAF Upper Heyford, UK. Program Element 63743F, Electronic Warfare Technology, funds advanced development efforts for a high powered jamming system. Program Element 72207F, Depot Maintenance, funds the installation of the EF-111A Tactical Jamming System. Program Element 64227F, Flight Simulator Development, funds development of initial Operational Flight Trainer, which will be located at Mountain Home AFB, ID.

6. (U) **WORK PERFORMED BY:** The prime contractor for the EF-111A Upgrade program is Eaton Corporation, AIL Division, Deer Park, Long Island, NY. The principal subcontractors are: Tasker Digital Radio Frequency Memory (DRFM), Whitaker Corp, Systems Division, Simi Valley, CA; Delco (processor), General Motors, Systems Operations, Goleta, CA; Comptek Research Inc. (software), Buffalo, NY; General Dynamics (integration), Fort Worth, TX. The development effort will be managed by Aeronautical Systems Division Wright-Patterson AFB, OH, and the installation will be accomplished by Sacramento Air Logistics Center, Sacramento, CA.

7. (U) **PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:** Not Applicable

8. (U) **SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:**

(U) **Project: 2066, EF-111A Upgrade**

A. **Project Description:** Update to the EF-111A is required to keep the tactical jamming system current against the evolving threat. Since the 1974 design cut-off point for the original jamming suite,

The update program will incorporate a new multiple processing encoder, a 1750 computer, 1553B data bus, two reprogrammable exciters, and new narrow band 7/8 antenna and software changes to allow the system to defeat the threat by placing concentrated jamming through improved power management on specific radars of interest.

B. (U) **Program Accomplishments and Future Efforts:**

Program Element: 64220F — Title: EW Counter Response
DOD Mission Area: 372 - Escort, Stand-off & Counter C^3 — Budget Activity: 4 - Tactical Programs

(1) (U) FY 1986 Accomplishments: Fabrication of full scale development kits. Preparations for Development Test and Evaluation and Initial Operational Test and Evaluation (DT&E/IOT&E) began. Contracting strategy for the full scale development was open competition for a fixed price incentive fee contract with production options.

(2) (U) FY 1987 Program: FY 1987 program includes system integration and checkout as well as aircraft modification and installation of an FSD kit. Preparation for DT&E continues. Reliability Qualification Testing begins.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: System simulator testing (DT&E and IOT&E) will be completed. Operational Flight Trainer (OFT) update will be placed on contract. Band 7/8 antenna development test will be placed on contract. Program cost estimates were obtained by RCA PRICE H Model for the hardware equipment, RCA PRICE S Model for the software, and an Aeronautical Systems Division hurestic technique for total life cycle cost. Program cost category is Level IV with a confidence level of III. Cost estimate data is considered good and is based on an eight week source selection and the RCA price models which led to a fixed price development contract with prepriced production options, awarded 3 October 1984.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Production decision will be made first quarter FY 1989. Activities include kit production, Lot II production option exercise, continued SPO support and P^3I.

(5) (U) Program to Completion: This is a continuing program. Kit deliveries will continue through 1992 and first kit install will occur in FY 1990 and continue through FY 1994.

C. (U) Major Milestones:

Milestones	Dates
(1) (U) Update Contract Awarded	3 October 1984
(2) (U) Preliminary Design Review	March 1985
(3) (U) Critical Design Review (Hardware)	September 1985
(4) (U) DT&E Test Complete	May 1988
(5) (U) Production Decision	December 1988
(6) (U) First Preproduction Kit Delivery	May 1990
(7) (U) First Install	June 1990

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64222F — Title: Nuclear Weapons Support
DOD Mission Area: 242 - Theater Wide Nuclear Warfare — Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	1,846	2,263	4,444	2,179	Continuing	N/A
5708	Nuclear Weapons Support	1,846	1,998	2,102	2,179	Continuing	N/A
3629	SAC Security Upgrades	0	265	2,342	0	2,000	4,607

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Project 5708 provides funds for salaries of the Air Force Weapons Laboratory cadre of civilian nuclear weapon specialists who provide technical guidance to the Department of Energy and direction to the North Atlantic Treaty Organization (NATO) for fulfillment of United States Air Force responsibilities related to the development and support of nuclear weapon systems. Includes funds to demonstrate weapon/warhead compatibility to delivery platforms. Supports Strategic Air Command (SAC) Required Operational Capability 16-71 (Peacekeeper), 12-76 (Air Launched Cruise Missile), 6-76 (B61 Strategic Bomb), 6-69 (B83 Modern Strategic Bomb), 15-83 (Short Range Attack Missile II), 1-83 (Small Single Reentry Vehicle Intercontinental Ballistic Missile), and Tactical Air Force Statement of Operational Need 304-77 (Ground Launched Cruise Missile). Project 3629 funds are provided for the development of SAC Security Upgrades of alert areas to protect nuclear weapons-loaded aircraft from terrorist attack. Military construction funds to install these devices are contained in Project Element 11896F starting in FY 1989.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	1,983	4,341	4,537	N/A	Continuing	-

EXPLANATION: (U) The Congress cut without prejudice $2.0 million from the SAC Security Upgrades Program in FY 1987. Reprogramming action has been initiated to restore these funds.

Program Element: 64222F Title: Nuclear Weapons Support
DOD Mission Area: 242 - Theater Wide Nuclear Warfare Budget Activity: 4 - Tactical Programs

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Project 5708						
Acquisition *						
B61						
B83						
Quantity						
B61						
B83						
Project 3629						
(U) Military Construction:						
3300 Funds	-	-	-	18,480	71,520	90,000

*Department of Energy Funded

5. (U) RELATED ACTIVITIES: Activities which are related to the warhead development in this program element include PE 64312F (Intercontinental Ballistic Missile Modernization), PE 64361F (Air Launched Cruise Missile (ALCM)), PE 64362F (Ground Launched Cruise Missile (GLCM)), PE 63319F (Advanced Cruise Missile (ACM) Technology), and PE 63364F (Short Range Attack Missile (SRAM) II). Activity related to nuclear weapon carrier modification/upgrade includes PE 11113F (B-52 Offensive Avionics System), PE 11115F (FB-111B/C), PE 11118F (SRAM), PE 11213F (Minuteman Squadrons), PE 64226F (B-1B), and PE 11126F (B-1B). Project 3629 construction funds (approximately $90 million) are included in PE 11896F. Bomber alert area obscuration devices and taxiway barriers developed and tested under Project 3629 will be constructed at Strategic Air Command bases.

6. (U) WORK PERFORMED BY: Work is primarily performed by the Air Force Weapons Laboratory, Kirtland AFB, NM.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. Project: 5801, Nuclear Weapons Support. Activities in this project include nuclear weapon development, nuclear weapon and delivery platform compatibility demonstration, support equipment certification, and nuclear weapon data development and evaluation efforts. Nuclear weapon programs either in development or production that are supported include the B83 and B61-3/4 gravity bombs, the B61-7 gravity bomb (safety and security upgrade of the B61-1 gravity ...), the W87 Peacekeeper, the W80 ALCM/ACM, and the W84 GLCM warheads. Weapon parachute development flight tests in ... of both new weapons and upgraded older weapons are also supported. Compatibility efforts include maintaining ...ification of US and North Atlantic Treaty Organization nuclear systems, providing for the development of ... practice bombs, and maintaining and updating all nuclear weapon related Technical Orders. The first

Program Element: 64222F Title: Nuclear Weapons Support
DOD Mission Area: 242 - Theater Wide Nuclear Warfare Budget Activity: 4 - Tactical Programs

production unit of the Peacekeeper warhead was built in April 1986 with no problems experienced. Stockpile Confidence Tests (SCT) of the B61-7 and the W56 (Minuteman II) were conducted in FY 1986 with no significant problems noted. An SCT of the W87 Peacekeeper warhead will be conducted in [ ] Several production problems were experienced with the W84 and the B83 during FY 1986. The W84 production was stopped on two occasions for quality problems discovered in electronic components and in solid state bonding procedures. Appropriate measures have been taken to remedy this situation. A stop work order was imposed pending results of a radiographic investigation of warheads at RAF Greenham Common, UK. This survey was completed the end of September 1986 and revealed that no warheads exhibited the problem. Based on this finding and additional test, the stop work order was rescinded. DOE believes that they can meet our delivery schedules for FY 1987. The B83 experienced similar problems and solutions are still being worked. At this time it appears that there are no operational impacts associated with these problems. In November 1986, the Short Range Attack Missile II (SRAM II) Project Officers Group (POG) and Small Intercontinental Ballistic Missile (SICBM) POG was formed as the warhead development programs enter Design Definition and Cost Study (Phase 2A). The Gramm-Rudman-Hollings Act significantly impacted the nuclear weapons program in two areas in FY 1986. The tactical bomb modernization program completion will be delayed by about three years. Reduction of the production rate of tactical bombs by half to accommodate reductions in the DOE FY 1986 authorization caused this delay. Additionally, the production schedules for Peacekeeper and Air Launched Cruise Missile (ALCM) warheads were modified to match [illegible] basis the missile delivery schedule. This introduces the potential risk of warhead availability [illegible] deployment. Nuclear weapon production will continue in FY 1987, 1988, and 1989 for the W87 Peacekeeper [illegible] B83 [illegible] the W80-1 ALCM/Advanced Cruise Missile warhead, the B61 tactical bomb, and the W84 [illegible] Cruise Missile (GLCM) warhead. In warhead development activities, the SRAM II and SICBM warheads will [illegible] development [illegible] in FY 1987. Production of the [ ] warhead for Peacekeeper will occur in FY 1988, [illegible] warheads [illegible] and quality assurance) being built in FY 1989. The W84 (GLCM) warhead will complete [illegible] in FY 1988 for a total build of [ ] Both the SRAM II and SICBM will enter enter Phase 4, production engineering, [illegible] FY 1989. There is a potential to start the development (Phase 2A) of a nuclear warhead for a Tactical Air-to-Surface Missile (TASM) during FY 1988. Depending on a Congressional decision to deploy more than 50 missiles, warhead production may continue in FY 1989. Strategic Relocatable Target and a Hard Target Kill weapons developments may be initiated in FY 1988.

B. (U) Project: 3629, SAC Security Upgrades. The Strategic Air Command (SAC) Security Upgrades program will commence in FY 1987, pending successful reprogramming action to restore $2.0 million cut, without prejudice, by the Congress. This two year development program is the research and development phase of a $90 million construction program to deploy bomber alert area obscuration devices and taxiway barriers. This program is in response to guidance that requires nuclear weapons security enhancements to protect against terrorist attacks. Two improvements were identified in CINCSAC's Security Upgrade program. Many SAC bomber alert areas are located close to base perimeters and are vulnerable to off base attack with small arms fire or rocket propelled grenades. Screening devices are being designed to obscure these nuclear weapons loaded aircraft from this potential attack. A prototype device will be installed at Grand Forks AFB, North Dakota in FY 1987 (pending successful reprogramming action). Through testing and operational evaluation, the design will be evaluated and refined. Based on the prototype tests, an engineering data package will be developed and used for the construction phase of the program. Construction is due to start in FY 1989. The majority of the FY 1988 effort will be devoted towards refining designs for the screening device and developing and refining designs for the

taxiway barrier. Currently the taxiways into the bomber alert area are protected by armed guards. Several concepts for barriers have been evaluated and designs are narrowing to a barrier cable device. Designs will be tested in FY 1989 in cold weather environments and designs finalized. Both programs will result in design that can be transition to the construction phase by FY 1989.

8. (U) **PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:** Not Applicable

9. (U) **COOPERATIVE AGREEMENTS:** Not Applicable

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64223F
DOD Mission Area: 225 - Air Warfare Support

Title: Alternate Fighter Engine (AFE)
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		29,562	105,050	86,915	28,078	44,051	525,891

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Provides funds to complete Full Scale Development (FSD) of the F110-GE-100 engine, as well as development and integration of configured engine bays in both F-15 and F-16 aircraft (provides capability to accept either F110 or F100 engines). Supports the competitive acquisition of durable, supportable, and affordable fighter engines for the expanding F-15 and F-16 fighter fleets which began with the FY 1986 aircraft engine deliveries. This program element also provides FSD funds for developing increased performance F100 and F110 engines by 1990 to give the F-15 and F-16 aircraft the capability of countering the improved threat at that time. The Increased Performance Engine (IPE) program leads to engine qualification in September 1988 for production availability in January 1990.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	32,482	109,376	89,393	N/A	0	474,222

EXPLANATION: (U) The decreases in FY 1986 and FY 1987 funding were due to both Air Force and Congressional reductions. The FY 1988 reduction resulted from revised inflation estimates.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: This program completes the development of the F110-GE-100 engine which was initiated under PE 64218F, Engine Model Derivative Program (EMDP). The EMDP on the F110 (previously F101 Derivative Fighter Engine) was conducted under a Memorandum of Understanding with the Navy. The Navy is planning to procure F110 engines to re-engine their F-14 aircraft fleet. The preliminary development for F100 and F110 IPEs is being performed under EMDP.

6. (U) WORK PERFORMED BY: The engine programs are managed by the Aeronautical Systems Division, Deputy for Propulsion, Wright-Patterson AFB, OH. The F110 and increased performance F110 programs are being conducted by the General Electric Company, Evendale, OH. The increased performance F100 engine program is being conducted by Pratt and Whitney, Government Products Division, West Palm Beach, FL. The F-16 Configured Engine Bay (CEB) development program is managed by the Aeronautical Systems Division, Deputy for F-16, Wright-Patterson AFB, OH. The F-16 CEB program is being

conducted by General Dynamics, Fort Worth Division, Fort Worth, TX. The F-15 CEB development program is managed by the Aeronautical Systems Division, Deputy for Tactical Systems, Wright-Patterson AFB, OH. The F-15 CEB program is being conducted by McDonnell Douglas Corporation, St. Louis, MO.

7. (U) PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: PE 64223F, Alternate Fighter Engine (AFE)

A. (U) Project Description: This program element funds the Full Scale Development (FSD) of the General Electric F110-GE-100 engine to provide a competitive alternative to the Pratt and Whitney F100-PW-220 engine. The Air Force competes these two engines each year under the AFE Competition, to fulfill the engine requirements for the annual F-15 and F-16 aircraft production. Also included in this program is the development of Configured Engine Bays (CEBs) for F-15 and F-16 aircraft that accept either the F110-GE-100 or the F100-PW-220 or the planned increased performance derivatives of these engines. Beginning in FY 1986, this program funded the FSD of F100 and F110 Increased Performance Engines (IPEs). These engines will incorporate advanced technology to provide higher thrust while maintaining current AFE levels of durability, operability, reliability, maintainability and supportability. IPEs will be available for incorporation in F-15 and F-16 CY 1990 aircraft deliveries.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Approximately $3.6 million funded the completion of F110 FSD efforts, which included in-process testing of a production configuration F110 engine prior to starting the Component Improvement Program for this engine. This concluded the F110-GE-100 development program. The development of the F-16 CEB was completed. The development of a CEB for F-15 aircraft continued with fabrication of development hardware. The overall development program for F100 and F110 IPEs, begun under the Engine Model Derivative Program (PE 64218F), continued with detailed design and procurement of FSD engine hardware matched to a production configuration.

(2) (U) FY 1987 Program: The FSD of the IPEs will continue. Production designs will be completed and development of unique support equipment, technical orders and other logistic support articles will begin. FSD test engines will be fabricated and assembled. Sea level engine testing for Initial Service Release (ISR) will be initiated. Flight testing of pre-production engines will be initiated. The development of the CEB for F-15 aircraft will continue with static/fatigue tests and fit checks of a F110-GE-100 engine.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Subsequent F100/F110 IPE FSD funding will provide each contractor: (1) up to 300 hours of sea level development testing; (2) 200 hours of altitude testing at Arnold Engineering Development Center; and (3) a 4000 total accumulated cycles accelerated mission test for qualification. These tests will satisfy the ISR requirements. The FSD program for F100 and F110 IPEs also includes

flight testing of the ISR (production) configuration. This program will lead to a competitive procurement of either or both engines by FY 1990 for use in F-15 and F-16 aircraft to better meet the improved performance threat at that time. F-15 CEB work will continue with flight testing of a CEB-configured F-15 aircraft with an F100-PW-220 engine.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The F110 and F100 Improved Performance Engines (IPEs) will continue Full Scale Development (FSD) with full life testing of the pre-production configurations including up to 4000 cycles of accelerated mission testing (AMT) during FY 1989. This full life demonstration will satisfy part of the requirements of the fourth and final stage of FSD, Operational Capability Release (OCR), by identifying life-limiting design deficiencies prior to full rate production of the engines. The program will also include updating the technical data for the F100 and F110 IPEs and provide integration flight test support for these engines in the F-15 and F-16 flight test programs. F-15 Configured Engine Bay testing will complete in FY 1989.

(5) (U) Program to Completion: The F100/F110 IPE program will continue through FY 1990 with OCR testing on a production configured engine. This will include performing an engine AMT with the production engine to verify full engine life. Update of engine maintenance and support procedures will also be accomplished under OCR.

C. (U) Major Milestones:

Milestones for F110-GE-100 Engine	Dates
(1) (U) Production Verification Accelerated Mission Testing	January 1984
(2) (U) Production Verification Sea Level Testing	October 1984
(3) (U) Production Verification Altitude Testing	January 1985
(4) (U) Integration Flight Test (F-16XL)	January 1985
(5) (U) First Production Engine Delivery	February 1985
(6) (U) Production Verification Flight Test (F-16C)	June 1986
(7) (U) First F-16C/D Delivery with F110 Engine	July 1986

Milestones for F100/F110 Increased Performance Engines		Dates
(1) (U) Contract Go-Ahead		June 1985
(2) (U) Preliminary Design Review		November 1985
(3) (U) Critical Design Review		May 1986
(4) (U) Initial Flight Release		July 1987
(5) (U) Production Design Review	*(February 1988)	August 1987
(6) (U) Functional Configuration Audit		September 1988
(7) (U) Initial Service Release		September 1988

* Dates presented in FY 1987 Descriptive Summary.

Milestones for F100/F110 Increased Performance Engines (Continued)		Dates
(8) (U) Physical Configuration Audit	*(February 1989)	January 1990
(9) (U) First Production Engine Delivery		January 1990
(10) (U) Operational Capability Release	*(not included)	December 1990

* Dates presented in FY 1987 Descriptive Summary.

(U) Explanation of Milestone Changes

(5) (U) The Production design review milestone was moved from February 1988 to August 1987 to properly support the timetable for integrating the F100 and F110 Increased Performance Engines (IPEs) into the FY 1989 Engine Competition Buy Decision.

(8) (U) The Physical Configuration Audit milestone was changed so that the review could be conducted on hard-tooled production engine hardware rather than on development hardware manufactured from soft-tooling. This allows the baseline engine hardware configuration list to more accurately reflect the actual production hardware.

(10) (U) Operational Capability Release milestone added to overall IPE development schedule.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64231F   Title: C-17 Program
DOD Mission Area: 261 - Intertheater Airlift   Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		347,535	626,262	1,219,904	981,977	1,395,448	4,809,748

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Additional airlift capability is needed for rapid intertheater deployment of combat forces to support national objectives and for timely intratheater movement to meet forward area mobility requirements. Airlift is vital to meet U.S. mobility requirements and is tailored to respond to contingencies anywhere in the world. Specific tasks associated with the airlift mission area include deployment, employment (airland, airdrop and extraction), sustaining support, retrograde, and combat redeployment. The C-17 will be capable of performing the entire spectrum of airlift missions and is specifically designed to operate effectively and efficiently in both the intertheater and intratheater environments. Therefore, it will not only increase our overall airlift capability, but will be able to replace the lost capability from retiring some C-130 and C-141 aircraft beginning in the 1990s. The C-17 will be a modern technology aircraft capable of performing the airlift mission well into the 21st century.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	372,759	612,262	901,922	N/A	1,829,565	3,955,160
Aircraft Procurement	0	217,300	1,382,800	N/A	30,272,820	31,872,920

EXPLANATION: (U) RDT&E: FY 1986 difference(-$25.2 million) reflects Gramm-Rudman-Hollings and small business reductions. FY 1987 increase (+$14.0 million) results from the $65 million Congressional cut, tooling funds ($102.7 million) moved from procurement to RDT&E by the Appropriation conferees, the C-17's share of undistributed Congressional/DOD cuts, and application of revised inflation rates. FY 1988 increase (+$318.0 million) reflects realignment of funds between PE 64231F (C-17 Program) and PE 64227F (Flight Simulator Development) to match revised simulator funding requirements, tool fabrication funds moved from procurement to RDT&E, and application of revised inflation rates. Total estimated RDT&E cost increase (+$854.6 million) results from recovering FY 1986/1987 Congressional reductions in the outyears, the procurement funds Congress/DOD moved from procurement to RDT&E, and application of revised inflation rates. Procurement: FY 1987 reduction (-$168.2 million) reflects the Congressional movement of fund to RDT&E, their reduction (-$64.562 million) made to the original request, and the C-17's share of undistributed Congressional/DOD cuts. FY 1988 (-$659.1 million) and total estimated cost (-$1524.4 million) differences result from the decrease caused by using updated inflation rates, the decrease resulting from Congress/DOD moving tooling funds to RDT&E, and the increase caused by revised initial spares costs.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Aircraft Procurement						
Funds	0	49,076	723,700	1,093,700	28,482,000	30,348,476
Quantities	0	0	2	4	204	210

5. (U) RELATED ACTIVITIES: The Air Force is also pursuing near-term programs to provide additional airlift capability. These programs include procurement of C-5B aircraft in PE 41119F, C-5 Airlift Squadrons, KC-10s in PE 27222F, KC-10A, and increasing the Civil Reserve Air Fleet (CRAF) cargo capability in PE 41215F, CRAF Modifications. These acquisitions, in conjunction with C-17, are part of the Air Force Airlift Master Plan to provide a balanced program for additional airlift that will meet the Congressionally Mandated Mobility Study recommended minimum airlift capability. The C-17 aircrew simulator development program is funded in PE 64227F, Flight Simulator Development.

6. (U) WORK PERFORMED BY: A program office is established at Aeronautical Systems Division of Air Force Systems Command at Wright-Patterson Air Force Base, Dayton, OH. Douglas Aircraft Company, Long Beach, CA, has been selected as the prime contractor and was awarded a low-level development contract in July 1982. A full scale development contract was awarded in December 1985. The Air Force Flight Test Center and the Air Force Operational Test and Evaluation Center will conduct developmental and operational flight testing in the full scale development program.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: PE 64231F, C-17 Program

A. (U) Project Description: This program element develops C-17 aircraft which will carry outsized cargo over intercontinental distances into austere airfields. The C-17 is a major initiative to improve our rapid deployment capability, provide the lift capability to move heavy mechanized Army/Marine Corps equipment in-theater, and replace the capability lost from retiring some C-130 and C-141 aircraft beginning in the 1990s.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Activity to support the overall full scale development effort continued. Structural development testing during FY 1986 included completion of over 300 aircraft components for static strength, durability, and damage tolerance. A total of over 2,000 material coupons have been tested to date. Wind tunnel activity was completed with a total 3,500 hours of low speed testing, 550 hours of high speed testing, and 450 hours of flutter testing. Engine developmental testing included a 30 percent and 45 percent scale model test of reverser

sections and full scale boiler plate testing at Pratt and Whitney facilities. Avionics vendors were selected. Work commenced on an avionics development and integration facility. Organizational and intermediate level support equipment recommendations began to be submitted. Logistics support analyses and design-to-life cycle cost analyses were continued. Reliability and maintainability design tracking continued.

(2) (U) FY 1987 Program: The engineering drawing release rate will increase significantly. Structural development testing, design analysis, and design-to-life cycle cost studies will continue. Initial tool fabrication activity will begin. Logistics planning studies and logistics support analysis development will continue. Technical order publications will begin to be developed. Reviews during FY 1987 will include an air vehicle operational software preliminary design review, an air vehicle software system requirements review, and a Department of Defense milestone IIIa review for low rate production approval. The peculiar support equipment design analysis will continue, documentation of Support Equipment Recommendation Data (SERD) is planned to increase, initial support equipment development testing and technical data to support training systems efforts will begin. Tool planning and design effort will continue to increase along with increased emphasis on tool fabrication leading to the start of construction of the partial development fixture. Detailed planning for flight and laboratory testing will continue.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Full scale development will continue. Tooling activity will continue. Fabrication for the three full scale test RDT&E articles and the first two production aircraft will begin. Assembly of the flight test aircraft will begin. Subsystem development testing will continue. Systems simulator qualification testing for flight control systems, hydraulic systems and fuel systems will begin. The 90 percent structural and 90 percent systems design and drawing release milestone will occur. Air vehicle hardware and software critical design reviews will be completed. Peculiar support equipment design and SERD documentation will continue. Training systems and equipment efforts will continue. Logistics efforts including logistics support analysis, technical publications, maintainability and support studies and analysis will continue. Flight and laboratory detailed planning and laboratory testing will continue. RDT&E cost estimate is category II/mature.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Assembly of the durability test article, static test article, and the first two production aircraft will begin. The tooling effort to support low production requirements will be virtually complete. Continued development will take place on the development fixture. The organizational and intermediate support equipment preliminary design reviews will be completed. Planning for the RDT&E flight test aircraft air loads calibrations will be completed. Engineering design and drawing releases will reach the 100 percent point. Development of detailed test planning will concentrate on full scale durability and static articles, and the RDT&E test aircraft. Full scale engine testing will be initiated. Technical and logistics analyses will be continued. The technical data validation effort will be initiated using manufacturing articles. RDT&E cost estimate is category II/mature.

(5) (U) Program to Completion: Production design, assembly/test of durability/static test articles; design specifications on procurement items and software; and support equipment design will be completed. Subsystem and component development, flight simulator testing, and tooling and parts fabrication will be completed. Manufacturing assembly, flight test and systems evaluation will be completed on the full scale development flight test articles.

C. (U) Major Milestones:

		Milestones		Dates
(1)	(U)	Contract Award		July 1982
(2)	(U)	Defense Systems Acquisition Review Council (DSARC) II Decision		February 1985
(3)	(U)	Complete Air Vehicle Preliminary Design Review	*(1st Quarter FY 1986)	September 1985
(4)	(U)	Complete Air Vehicle Critical Design Review	*(1st Quarter FY 1988)	4th Quarter FY 1988
(5)	(U)	Begin RDT&E Test Article Assembly	*(1st Quarter FY 1988)	2nd Quarter FY 1988
(6)	(U)	First Flight	*(2nd Quarter FY 1990)	4th Quarter FY 1990
(7)	(U)	1 Life Cycle Complete on Durability Article		1st Quarter FY 1991
(8)	(U)	Development Test and Evaluation/Initial Operational Test and Evaluation Complete (except all-weather testing)	*(3rd Quarter FY 1991)	1st Quarter FY 1992
(9)	(U)	Initial Operational Capability	*(3rd Quarter FY 1992)	4th Quarter FY 1992

* Date presented in FY 1987 Descriptive Summaries.

(U) Explanation of Milestone Changes

(3) (U) Air vehicle preliminary design review was formally completed ahead of schedule in September 1985.

(4) (U) The preliminary design review and critical design review process covers numerous system elements (i.e., air vehicle, airframe, support equipment, simulators, and avionics hardware and software). We will track air vehicle design review schedule to accurately reflect any program changes. Completion of air vehicle critical design review has slipped to the fourth quarter FY 1988 due to the FY 1986 Congressional and Gramm-Rudman reductions.

(5) (6) (8) and (9) (U) The start of RDT&E test article assembly, first flight, completion of Development Test and Evaluation/Initial Operational Test and Evaluation (except all-weather testing), and Initial Operational Capability slipped because of the RDT&E schedule change resulting from the Gramm-Rudman reduction and showing the full impact of the FY 1986 Congressional reduction.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

Budget Activity: 4, Tactical Programs
Program Element: 64231F, C-17 Program

Test and Evaluation Data

1. (U) Development Test and Evaluation (DT&E): Wind tunnel, structural and component testing has been conducted during the low level development and initial full scale development (FSD) phases of the program. Major test phases will be development ground testing, combined DT&E/Initial Operational Test and Evaluation (IOT&E), dedicated IOT&E, climatic hangar, hot weather climatic test deployment and post cold weather climatic deployment, and production acceptance test and evaluation. DT&E will be conducted to assist engineering design and development, verify accomplishment of specification requirements, characterize system performance, and insure critical issues have been sufficiently resolved to permit a full rate production decision. DT&E/IOT&E will be conducted using one FSD aircraft and four production aircraft. These aircraft will be tested at government test sites except for the first flight. Combined DT&E/IOT&E testing will be conducted at Edwards AFB, CA, under a combined test force with the Air Force Flight Test Center taking the lead in DT&E. Development tests include flying qualities, performance, airdrop as well as reliability, maintainability, and availability.

2. (U) Operational Test and Evaluation (OT&E): Initial testing will be accomplished under a combined DT&E/IOT&E concept. Air Force Operational Test and Evaluation Center (AFOTEC) will take the lead in operational testing which will be conducted by a combined test team with AFOTEC, Air Force Flight Test Center, US Army, and US Marine Corps participation. Testing will be conducted under day/night adverse weather conditions and will consist of evaluations in the following areas: ground operations at both a main operating base and a small, austere airfield to include quick reaction capability, quick turnaround time, and ground handling characteristics and procedures; inter/intra-theater airland/airdrop missions, air refueling, aeromedical evacuation, formation, and low-level operations; crew/system interface; compatibility/interoperability with elements of the Air Force airlift system and with other government agencies and forces of the Army and NATO; training requirements and concepts; operational assumptions used to project service life; survivability; software effectiveness, usability, and maintainability; system reliability and maintainability; logistics supportability, and operating and support cost elements of the life cycle cost model. In addition, a minimum of five aircraft months of dedicated IOT&E will be conducted to assess unique IOT&E objectives. These tests will be conducted in a realistic operational environment (i.e., deployment to an operational Military Airlift Command (MAC) base where composite operational missions will be flown into and from MAC and Army bases). Testing will be conducted using Air Force "hands-on" maintenance to the maximum extent feasible.

3. (U) Systems Characteristics: All system performance, reliability, maintainability, and availability characteristics are specified in the contract with McDonnell Douglas Corporation. Demonstrated characteristics will not be available valid until FY 1992.

Characteristic	Objective/Threshold	Demonstrated
Aircraft Dimensions (Height, Length, Wing Span)	55.3' x 175.2' x 165.0'	

Budget Activity: 4, Tactical Programs
Program Element: 64231F, C-17 Program

Characteristic	Objective/Threshold	Demonstrated
Cargo Compartment Dimensions (Height, Width, Length)	12.3' x 18.0' x 88.0'	
Max Allowable Cabin Load (ACL)	172,200 lb	
Range (166,965 ACL)	2,400 NM	
Takeoff Critical Field Length (2,400NM/166,965 ACL)	7,600 ft	
Maximum Effort Landing Fielf Length (123,977 ACL/500NM return)	2,650 ft	
Cruise Speed	0.77 Mach	
Ground Maneuvering (runway width, 180 degree turn using backing)	90 ft	
Reliability @ 100,000 fleet flying hours (system mission completion success probability)	93 %	
Maintainability @ 100,000 fleet flying hours (air vehicle maintenance manhours per flight hour)	18.6	
Availability @ 100,000 fleet flying hours		
(full mission-capable rate)	74.7 %	
(partial mission-capable rate)	82.5 %	

4. (U) Current Test and Evaluation (T&E): DT&E/IOT&E flight testing is not currently planned until FY 1990.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64236F
DOD Mission Area: 221 - Counter Air

Title: Infrared Search and Track System (IRSTS)
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		10,218	31,237	14,055	4,876	2,458	62,844

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This is a joint Air Force and Navy development program of an infrared search and track system (IRSTS).

Supporting requirement documents include Air Defense Tactical Air Command (ADTAC) Statement of Need (SON) 10-70 (revalidated July 1983), Tactical Air Force (TAF) SON 304-83, Advanced Tactical Fighter/Air-to-Air, (validated November 1984) and TAF SON 308-84 for Fighter/Interceptor IRSTS (in final validation). The nonradiating IRSTS complements the radar and expands the aircraft's capability by increasing the detection range of high altitude or low radar cross section (RCS) targets and by allowing earlier raid cell assessment. It will operate in jamming environment and does not act as a homing beacon to air-to-air anti-radiation missiles.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	23,054	34,846	43,462	N/A	Continuing	Continuing

(U) EXPLANATION: The FY 1986 - 88 funding changed due to a major program restructure as a result of Air Force decision to continue in Advanced Development versus proceeding into Full Scale Development for Air Force F-15 fighters. The Advanced Development program will include joint efforts to baseline the performance of both midwave (3-5 micron) and longwave (8-12 micron) systems. NOTE: FY 1986 funding was reduced following the restructure by reprogramming actions to other USAF programs.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: This is a Joint Air Force/Navy development program. Flight test of the Advanced Demonstration Model by two contractors was completed in November 1985. Due to the Air Force's decision not to proceed into a F-15 Full Scale Development (FSD) but to continue with an advanced development program, a program restructure was required. A Memorandum of Agreement (MOA) was signed on 22 July 1986 at the Assistant Secretary of the Air Force and Navy levels for a restructured joint development program. Under this program, the Navy and Air Force will share costs in a joint technology improvement effort to include improvements in the midwave system and the development of a longwave system. The Navy will fully fund an F-14D IRSTS FSD program. The data obtained from PE 64236F will directly support the Advanced Tactical Fighter (ATF) program, PE 63230F, by providing the technology base for defining ATF development/operational requirements for an IRSTS.

6. (U) WORK PERFORMED BY: The advanced development work is being performed by General Electric Company, Aerospace Electronics Systems Department, Utica, N.Y.. The IRSTS FSD Request for Proposals was released in 4th Qtr FY 1985 as a full and open competition effort. Only GE responded with submission of technical and cost proposals. A contract modification was distributed to GE in May 1986 to continue advanced development. A new contract award to GE for continued technology improvement to midwave system, development of a longwave system and F-14D FSD is planned for 2nd Qtr FY 1987. McDonnell Aircraft Company, St. Louis, MO will be the associate contractor for F-15 flight test integration of the improved system while Grumman Aircraft Company, Long Island, N.Y. will be the prime contractor with the Navy for F-14D integration. Air Force Systems Command Aeronautical Systems Division is the Air Force Agency in charge of this program.

7. (U) PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 64236F, Infrared Search and Track System (IRSTS)

(U) Project Description: This is a joint development program for a fighter IRSTS program. The IRSTS technology is also applicable to the USAF Advanced Tactical Fighter (ATF) and the Navy Advanced Tactical Aircraft (ATA). See paragraph 2 for additional information.

A. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Completed Advanced Development Model (ADM) flight test program in the first quarter. Tactical Air Command (TAC) withdrew support to proceed into the joint FSD program for the F-15 fighter due to high costs of retrofit. The TAC decision required a complete restructure of the joint program. The new program continues advanced development on midwave IRSTS, initiates development of a longwave system and allows the Navy to proceed on schedule with a FSD program to incorporate the IRSTS into the F-14D. The Air Force and Navy drafted a new MOA and contracts for the restructured program. Air Force laboratories began studies on the effect of atmosphere on IRSTS and IR signatures. Preliminary Design Review was held in August 1986.

(2) (U) FY 1987 Program: Conduct Critical Design Reviews. Conduct ground laboratory testing to prove out optical improvements to the Advanced Development Model (ADM). Begin flight tests on improved ADMs on integrated pod with F-15A test bed. Begin work on improved clutter rejection algorithms, focal plane arrays, and cryogenic cooling. Begin fabrication of four test units for full up demonstration validation testing of both improved electronics and software. Design and fabricate detectors for a longwave system. Continue atmospheric and signature studies.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Perform full-up demonstration and validation flight testing of improved test units on F-14A test bed. Two units will be delivered to the Navy for F-14D integration and airframe compatibility checkout. Begin fabrication of the longwave system. Complete F-15A improved ADM flight tests and provide test results to develop the data base for Advanced Tactical Fighter IRSTS sensor suites. The costs should be considered as Category IV planning estimates until complete estimates on the restructured program become available from contractor estimates. The estimates were submitted by the IRSTS program office during September 1986.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Complete demonstration and validation flight testing of improved midwave units. Flight testing will begin on the longwave system.

(5) (U) Program to Completion: Complete development and flight testing of the longwave IRSTS units. The Air Force will make a decision on IRSTS incorporation on specific airframes following a review of the IRSTS performance during the demonstration and validation phase. The Navy will incorporate the IRSTS into the F-14D production line.

C. (U) Major Milestones:

Milestones		Dates
(1) (U) Preliminary Design Review (PDR)		August 1986
(2) (U) Critical Design Review (CDR)	*(1st Quarter FY 1987)	2nd Quarter FY 1987
(3) (U) Improved Optics Flight Test		4th Quarter FY 1987
(4) (U) Navy Integration Model Delivery		March 1988
(5) (U) First Flight Full-up Demonstration/Validation		June 1988

* Date presented in Fiscal Year 1987 Descriptive Summary.

(U) Explanation of Milestone Changes

(2) (U) Changes due to later contract award resulting from program restructure.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64237F
DOD Mission Area: 221 - Counter Air

Title: Variable Stability In-Flight Simulator Test Aircraft
Budget Activity: 4 - Defense Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	331	7,733	6,249	14,380	8,914	37,607
3308	Variable Stability In-Flight Simulator Test Aircraft (VISTA)	331	7,733	6,249	14,380	8,914	37,607

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program develops a high-performance fighter in-flight simulator as a replacement for the NT-33A. For the past 28 years the R&D flight test community (Air Force, Navy, National Aeronautics and Space Administration, industry) has extensively employed the variable stability NT-33 for pre-first flight analysis of modern fighters, to establish flying quality specification criteria, and as a flying laboratory for control/display elements. The NT-33A has been a veritable workhorse with a full schedule of test activities. Its success is directly attributable to its relatively low cost of operation, rapid response to customer needs, and high degree of credibility in the flight test community. However, the NT-33A performance (41 year old aircraft design) is no longer representative of future fighter performance and must be replaced by the Variable Stability In-Flight Simulator Aircraft (VISTA), a modified F-16D. VISTA will identify crucial flight control and human factor design deficiencies for correction before final design review of weapon systems. The NT-33A has been credited with identification of flight control deficiencies on both the YF-17 and F-18 aircraft, which likely would have resulted in loss of these aircraft had the defects not been corrected prior to first flight. With VISTA, the Air Force and Navy Test Pilot Schools will train test pilots to identify flying quality, avionics system, and human factor deficiencies/characteristics in a realistic high performance environment. VISTA will serve as a national facility for Air Force, Navy, NASA, industry, and international flying research.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	381	8,680	14,431	N/A	9,744	33,236

EXPLANATION: The decrease in FY 1986 funding is due to reprogramming to higher priority programs. The decrease in FY 1987 funding is due to Congressional action. The decrease in FY 1988 and the increase in Total Estimated Cost is due to alterations in program structure based on refined planning and cost estimates to field single VISTA with minimum initial capability and high potential for upgrade.

4. (U) OTHER APPROPRIATION FUNDS: Not applicable.

5. (U) RELATED ACTIVITIES: This program receives technology inputs from Aerospace Flight Dynamics (PE 62201F). In turn, the technology product of this program will be applied to Flight Vehicle Technology (PE 63205F) and Advanced Flight Technology Integration (PE 63245F). Coordination and avoidance of duplication of effort with other Air Force organizations, the Army, the Navy, and the National Aeronautics and Space Administration is accomplished through exchange of information, coordinating and advisory groups, and program reviews.

6. (U) WORK PERFORMED BY: The program is managed by the Flight Dynamics Laboratory, Wright-Patterson AFB, OH. Contractor(s) for the program will be competitively selected in the last quarter of FY 1987.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3308, Variable Stability In-Flight Simulator Test Aircraft (VISTA)

A. (U) Project Description: An F-16D fighter will be modified with variable stability controls to perform flight research in flying qualities, flight control, and avionics technology. A conceptual design study was initiated as a laboratory effort in FY 1982 and completed in FY 1986. Technical design and cost trade-off (acquisition and life cycle) studies were performed for candidate aircraft. To ensure that the VISTA meets the needs of all the users, a steering group of Air Force, Navy, and National Aeronautics and Space Administration users was formed to review and establish program requirements. Based upon long experience with in-flight simulators, the VISTA project is technically a low risk program. A proven F-16D airframe will be modified. Components (computers, sensors, servos, etc.) for the variable stability controls are readily available off-the-shelf or can easily be modified to satisfy requirements. The digital fly-by-wire technologies involved have been validated in the Advanced Flight Technology Integration (AFTI)/F-16, the X-29, and F-18.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: The VISTA conceptual design study was completed. Candidate aircraft configurations were subjected to preliminary low and high speed wind tunnel testing in order to provide a baseline for control surface effectiveness and aerodynamic effects. Program planning was carried out through preparation of an acquisition plan, program management plan, and statement of work for the "request for proposal" phase of the effort. Efforts to define the configuration of the assigned F-16D, including production-line modifications were initiated.

(2) (U) FY 1987 Program: The assigned F-16D will be procured under the existing F-16 System Program Office contract. Analyses of hydraulic and electrical system modifications required to accommodate the variable stability system operation will be conducted. VISTA's unique instrumentation (sensors, data recording systems, etc.) will be designed. The technical issues associated with the locations of displays and controls critical to safety-of-flight, including the tactile feedback controls, will be addressed. The request for proposals to modify the aircraft to incorporate the VISTA unique modifications will be issued.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The host F-16D aircraft will be delivered and fabrication and assembly of cockpit modifications will begin. Installation of other subsystems will be initiated. Subsystems include sensor modifications, variable stability system components, and extensive hydraulic and electrical system rework prior to wing assembly and attachment. The two-seat cockpit will be extensively modified with the front seat being the test pilot seat, and will include programmable displays and variable feel/displacement controls. The rear seat will be modified to be the safety pilot position. Variable Stability System (VSS) control integration with the F-16D flight control system will be initiated.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Variable Stability In-Flight Simulator Test Aircraft (VISTA) unique hardware installation will be completed. The wing assembly will be mated with the airframe and heavy weight landing gear will be mounted. Cockpit modifications will be completed. The VSS software development will be completed and validated in simulators. The VSS hardware and software installation and the cockpit modifications will be checked out. The ground and flight test plans will be developed.

(5) (U) Program to Completion: Extensive ground testing and analysis will be conducted to ensure that system operations meet safety and design requirements. A four month flight test program will be conducted to verify system operational performance. Completion of flight test and transition to flight research programs is planned for FY 1990.

C. (U) Major Milestones:

Milestones		Dates
(1) (U) Request for Proposal	*(3rd Quarter FY 1986)	3rd Quarter FY 1987
(2) (U) Source Selection Completed	*(4th Quarter FY 1986)	4th Quarter FY 1987
(3) (U) Award Contract	*(1st Quarter FY 1987)	1st Quarter FY 1988
(4) (U) System Design Completed	*(4th Quarter FY 1987)	4th Quarter FY 1988
(5) (U) Aircraft Modification Completed	*(4th Quarter FY 1988)	4th Quarter FY 1989
(6) (U) Ground Check-out Completed	*(4th Quarter FY 1988)	1st Quarter FY 1990
(7) (U) First Flight	*(1st Quarter FY 1989)	2nd Quarter FY 1990
(8) (U) Flight Test and Certification Completed	*(4th Quarter FY 1989)	4th Quarter FY 1990
(9) (U) Transition to Flight Research Program	*(1st Quarter FY 1990)	4th Quarter FY 1990

* Date presented in FY 1987 Descriptive Summary.

(U) Explanation of Milestone Changes

(1-9) Detailed planning studies and cost analyses, conducted from March to July 1986, yielded an adjustment of program content and scheduling. Schedules have been timed to coincide with F-16 delivery date of 3rd Quarter FY 1988.

9. (U) COOPERATIVE AGREEMENTS: Not applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64247F
DOD Mission Area: 225 - Air Warfare Support

Title: Modular Automatic Test Equipment (MATE)
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		12,777	19,184	18,373	16,302	Continuing	N/A
2503	MATE	12,777	19,184	18,373	16,302	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Previous and current methods used to specify, design, build and support automatic test systems (ATS) have resulted in a proliferation of equipment, low operational reliability and supportability, and increased life cycle costs. A major reason why aircraft availability (force readiness) is below desired levels is because of malfunctioning or unsuitable ATS at all organizational levels. The MATE program has developed a set of guides which delineate a standard architecture and a management system for ATS and established a framework for the acquisition and support of future Air Force ATS. In addition, a government owned MATE Operations Center will be developed to manage the MATE developed hardware and software standards, as well as perform verification testing on proposed MATE modules.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	9,683	23,682	26,459	N/A	Continuing	N/A

EXPLANATION: (U) The $3.094 million increase in FY 1986 satisfies an unfunded requirement to continue lease of the contractor-owned MATE module verification facility. The $4.498 million decrease in FY 1987 is due to a direct Congressional reduction of $3.682 million and undistributed Congressional reductions (i.e., inflation, profit policy) totalling $0.816 million. The $8.086 million decrease in FY 1988 is due to higher priority requirements and undistributed Congressional reductions (i.e., inflation, profit policy).

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: To prevent duplication, all cognizant Army, Navy and Air Force organizations are supplying inputs to reviews of the MATE program and guides. The MATE Program Office supports the Joint Logistics Commanders (JLC) Panel on Automatic Testing as funds and personnel permit. The Army and Navy continuously evaluate MATE products for inclusion in their ATS via the JLC Panel. The Navy developed built-in test design guides, and the fault isolation/fault detection work being done at the Air Force Rome Air Development Center will provide a basis for decisions concerning the partitioning of test functions between the ATS and built-in test equipment. The Navy has developed, in conjunction with

the Army and Air Force, the military standard on testability used in the MATE program, "Testability Program for Electronic Systems and Equipment." An industry MATE Users Group (MUG) was formed as a subgroup of the Automatic Testing Committee of the National Security Industrial Association (NSIA) to provide a wide forum and feedback for MATE progress and policy. Program Element (PE) 27131F, A-10 Squadrons provided funds for procurement of up to 27 intermediate automatic test system (IATS) stations for the A-10 inertial navigation system (INS). The IATS is the first application of MATE to intermediate-level automatic test systems (ATS).

6. (U) WORK PERFORMED BY: This program is being implemented by the Support Equipment Systems Program Office of the Aeronautical Systems Division at Wright-Patterson AFB, OH. Supporting laboratories are the Air Force Avionics Laboratory, located at Wright-Patterson AFB, OH, and the Rome Air Development Center at Griffiss AFB, NY. The system definition contractors were the Sperry Corporation, Great Neck, Long Island, NY; Westinghouse Electric Co., Hunt Valley, MD; Technology Development Corporation, Arlington, TX; and the Emerson Electric Co., St. Louis, MO. The MATE Operations Center is managed by the Directorate of Material Management of the San Antonio Air Logistics Center at Kelly AFB, TX.

7. (U) PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2503, MATE

A. (U) Project Description: Implementation and use of the MATE system as defined in the MATE Guides will result in the design and production of ATS which meet Air Force readiness requirements. The MATE system assures adequate support for our forces in a more cost effective manner and, at the same time, provides for standardized interfaces, simplifies the support of ATS and controls proliferation of test system hardware and software. The first applications of the MATE system were the IATS for the A-10 INS and the Depot Automatic Test System for Avionics (DATSA). The acquisition of these automatic test systems was supported as part of the MATE full scale development program; these systems were developed using non-MATE funds. While the framework (manuals, specifications, Guides and tools) for future ATS have been developed as a baseline to meet today's needs, continued development and enhancement of the MATE architecture is necessary to include other ATS application areas, prevent technical obsolescence, and allow all new ATS to be supported from a common base of logistics and engineering resources. New technologies to be included in the MATE Guides and standards include: electro-optics, radio frequency, the Ada language, Very High Speed Integrated Circuits (VHSIC), pin electronics, flight-line mobile "suitcase" testers, fiber optics, hydraulics, and pneumatics. The MATE system also has a continuing need for an organic capability to support and distribute the MATE developed products (i.e., MATE Guides, standards, acquisition tools, and standard software); perform MATE module verification testing; train all levels of acquisition managers in MATE acquisition and support procedures; provide technical support to ATS acquisition programs; and test new ATS technologies. As new technologies are infused into the MATE program, they must be supported by the MATE Operations Center. The establishment of the organic MATE Operations Center will provide the Air Force with positive/absolute control of the MATE developed products and standards and enhance corporate memory, program viability, and continuity. These efforts, currently being performed by an independent contractor, can foster greater competition and avoid potential proprietary rights conflicts if done by the Air Force.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: This project completed operational testing of the A-10 Inertial Navigation System (INS) Intermediate Automatic Test System (IATS) and kept MATE abreast of the test requirements generated by new Unit Under Test (UUT) technology by initiating incorporation of new technologies such as VHSIC and "suitcase" testers into MATE. This project maintained and updated the established institutional framework for the Air Force to continue development and application of the MATE concept. This project delivered a MATE verification station to the MATE Operations Center; continued development and enhancement of the organic capability to maintain, support and distribute MATE developed products; and continued work on self-improving diagnostics (SID) and automatic test program generator (ATPG) systems to improve UUT test software. Lease of the contractor-owned MATE module verification facility continued.

(2) (U) FY 1987 Program: This project will continue the development of MATE by incorporating software enhancements into the operating system and ATLAS compiler, and developing/refining standards to apply advanced technologies to automatic test system (ATS) acquisitions. New technologies investigated in earlier phases (e.g., VHSIC) will begin to be implemented and integrated into the MATE standards and interfaces. The investigation to convert the MATE Control and Support Software (MCSS) to Ada from JOVIAL will begin. Support to the Joint Logistics Commanders (JLC) Panel on Automatic Testing and the Institute of Electrical and Electronic Engineers (IEEE) ATLAS standards will continue. Initial Operational Capability (IOC) of the module verification station at the MATE Operations Center will be achieved. Lease of the contractor owned MATE module verification facility will continue to clear the backlog of candidate modules awaiting verification testing. Development of equipment to perform the other functions of the MATE Operations Center (e.g., support of the MCSS and the automated acquisition tools) will continue.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: This project will implement and expand the development of MATE by incorporating software enhancements into the control and support software and ATLAS compiler. The MATE Guides will be further developed by refining standards that apply advanced technologies to ATS acquisitions. Restructure of the MATE Guides into a more usable format will begin. New technologies (e.g., fiber optics, pin electronics) investigated in earlier phases will be integrated into the standards and interfaces. The conversion to Ada software will begin. The identified VHSIC insertion candidates will be supported as well as other new technologies. The MATE Operations Center will achieve full operational capability for the verification of hardware and software modules and to support the system software, ATLAS compiler, acquisition tools, and quality assurance tools. Lease of the contractor owned MATE module verification facility will continue in order to clear the backlog of modules awaiting verification testing. The UUT Simulator will be completed and become available for use in development and testing of software test programs. Support to the Joint Logistics Commanders (JLC) Panel on Automatic Testing and the Institute of Electrical and Electronic Engineers (IEEE) ATLAS standards will continue. Cost estimates for this project are at Level III, Budgetary, and are based on program office experience and priced contractor agreements.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: This project will complete the restructure of the MATE Guides into a more useable format for program offices and industry. Initial Very High Speed Integrated Circuits (VHSIC) standards will be incorporated into the MATE Guides. The MCSS will be updated to incorporate enhancements such as real time test capability to provide continuing support to new ATS developments. Computer standards and

MATE interface standards will be upgraded and refined to incorporate advanced avionics and test technology. Standards and software for "suitcase" testers will be developed. Newly developed products and technologies will be transferred to the MATE Operations Center for ongoing support of Air Force programs. Support to the Joint Logistics Commanders (JLC) Panel on Automatic Testing and the Institute of Electrical and Electronic Engineers (IEEE) ATLAS standards will continue.

(5) (U) Program to Completion: This is a continuing effort to develop, implement and support new automatic test system (ATS) technologies (e.g., fiber optics) to keep the MATE concepts and standards abreast of the ATS support requirements of future Air Force weapon systems; this includes technology areas such as pin electronics, flight-line mobile "suitcase" testers, fiber optics, hydraulics and pneumatics. Conversion of MATE software from JOVIAL to Ada will continue.

C. (U) Major Milestones:

Milestones	Dates
(1) (U) MATE Full Scale Development Phase I Completed	September 1985
(2) (U) A-10 IATS Operational Test and Evaluation Completed	September 1986
(3) (U) MATE Operations Center Full Operational Capability	November 1987
(4) (U) MATE VHSIC Standard Completed	4th Quarter FY 1987
(5) (U) Restructured MATE Guides Completed	4th Quarter FY 1988
(6) (U) Unit Under Test (UUT) Simulator Completed	4th Quarter FY 1988
(7) (U) MATE Pin Electronics Standard Completed	4th Quarter FY 1988
(8) (U) MATE Fiber Optics Standard Completed	FY 1989
(9) (U) Ada Conversion Completed	FY 1991
(10) (U) Update and Enhance MATE Architecture	Ongoing

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64248F
DOD Mission Area: 223 - Close Air Support and Interdiction

Title: Modular Standoff Weapons Program
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		0*	0*	39,175	39,255	TBD	TBD
3375	Modular Standoff Weapons (MSOW)	0*	0*	39,175	39,255	TBD	TBD

* Funds contained in PE 63790F

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Program Element provides funds to complete project definition and begin full scale development of MSOW variant(s). MSOW was initiated using FY 1986 and FY 1987 funding as a new NATO cooperative weapons development program, and implemented Section 1103 of the 1986 and 1987 Authorization Acts (Nunn Amendment). The program will develop a series of standoff weapons to enhance NATO conventional defense capabilities.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: Not Applicable.

4. (U) OTHER APPROPRIATION FUNDS: Not applicable.

5. (U) RELATED ACTIVITIES: The Modular Standoff Weapons program will incorporate technologies from PE 62602F, Conventional Munitions; PE 63601F, Conventional Weapons Technology; and PE 63790F, NATO Cooperative Research and Development.

6. (U) WORK PERFORMED BY: Air Force Systems Command, Andrews AFB, MD, will manage any efforts under this PE. Specific Product Division or contractor undetermined pending an Office of Under Secretary of Defense for Acquisition (OUSD(A)) approval of projects.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3375, Modular Standoff Weapons

A. (U) Project Description: The Modular Standoff Weapons (MSOW) program is a cooperative Research and Development initiative proposed under the Nunn Amendment. Seven countries have signed a Letter of Intent to pursue the

further definition of a modular approach to standoff weapons. These seven countries are the US, Germany, UK, France, Spain, Canada, and Italy. The purpose of the program will be to build a series of both short and long range standoff weapons using a modular approach. The short and long range weapons built using this approach will be able to attack a variety of targets such as airfields; air defense units; hardened command, control, and communication nodes; and armor. A product of this effort will be improved interoperability and standardization within NATO.

B. (U) Program Accomplishments and Future Efforts: Accomplishments for FY 1986 and those anticipated for FY 1987 are funded in PE 63790F, NATO Cooperative Research and Development.

(1) (U) FY 1986 Accomplishments: Seven Power National Armament Directors (US, Germany, UK, France, Spain, Canada, and Italy) signed a Letter of Intent to pursue a cooperative standoff weapons program at the 26-27 February 1986 Conference of National Armaments Directors (CNAD) meeting. In September 1986, representatives of the seven countries signed a preliminary understanding to proceed with a Request for Information (RFI) and a Request for Proposal (RFP) to obtain early industrial participation in the Modular Standoff Weapons program (MSOW). An RFI was released to industry in mid-September 1986.

(2) (U) FY 1987 Program: An RFP for a project definition/prototype demonstration (PD) phase will be released in the second quarter of FY 1987. The seven participating countries will select two to three consortia to conduct competitive demonstrations of the modularity concept, and contracts for the selected consortia will be awarded in September 1987. The purpose of the PD Phase will be to reduce the risk of follow-on Full Scale Development (FSD) phase and to provide comparative testing of competing system designs and modules. The governments expect the PD phase to last approximately three years.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Work on the PD phase will continue. As envisioned, the PD phase will consist of design definitions; ground, captive flight and free flight testing; and integration of modules incorporating near-term technology for the expeditious fielding of the initial variant(s) while at the same time working on modules containing longer term technology for application to subsequent variants.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Work on the PD phase will continue with emphasis on free flight testing.

(5) (U) Program to Completion: In September 1990, one consortium will be selected to begin FSD of the initial variant of the Modular Standoff Weapons program. PD phase results will be used to determine sequence of variant FSD, and it may be possible to conduct variant FSD efforts in parallel. However, six of the seven nations have stated that their most urgent requirement is for the development of a short range standoff weapon to attack airfields. The FSD phase for one variant will take approximately 2 1/2 years. Due to the benefits of modular design, it is expected that subsequent variant FSD will be shorter and less expensive than the first FSD effort. FSD will be conducted in a leader/follower arrangement to allow for the competition in what is envisioned to be an extensive production phase.

C. (U) Major Milestones:

		Milestones	Dates
(1)	(U)	Seven Power Letter of Intent Signed	February 1986
(2)	(U)	Preliminary Understanding Signed	September 1986
(3)	(U)	Release of Request for Information (RFI)	September 1986
(4)	(U)	Industry Replies to RFI	November 1986
(5)	(U)	Memorandum of Understanding Signed	2nd Quarter FY 1987
(6)	(U)	Release of Request for Proposal (RFP)	2nd Quarter FY 1987
(7)	(U)	Industry Replies to RFP	June 1987
(8)	(U)	Contracts Awarded	September 1987
(9)	(U)	Project Definition Phase Complete/FSD First Variant(s) Begins	September 1990

9. (U) COOPERATIVE AGREEMENTS: Statement of Intent was signed February 1986 to explore the concept of a family of modular weapons. The seven countries currently involved in negotiations are the United States, the United Kingdom, Germany, Spain, France, Canada, and Italy. A Preliminary Understanding was signed September 1986 by the Air Senior National Representatives of the participating countries. The Preliminary Understanding outlines principles to be used in the drafting of the umbrella Memorandum of Understanding (MOU) and protects national information used during the preliminary work leading to the Project Definition Phase. The umbrella MOU covering the Modular Standoff Weapon along with the Project Definition Phase supplement are being negotiated with a goal to obtain national ratification by the first quarter of calendar year 1987.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64249F
DOD Mission Area: 223 - Close Air Support and Interdiction

Title: Night/Precision Attack
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	36,857	38,766	19,851	4,689	5,056	529,799
2693	Low Altitude Navigation and Targeting Infrared System for Night (LANTIRN)	36,857	38,766	19,851	4,689	5,056	529,799

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The LANTIRN program includes development and testing of a wide angle raster Head-Up Display, a navigation pod, and a targeting pod. The navigation pod contains a terrain following radar and a fixed forward looking infrared (FLIR) sensor; the targeting pod contains a gimballed FLIR, a laser designator, an automatic tracker, a missile boresight correlator, and growth provisions for an automatic target recognizer. The need for LANTIRN is documented in Tactical Air Forces' Statement of Operational Need 302-81, Night Attack Capabilities. LANTIRN responds to that need by providing the capability to conduct close air support and interdiction missions at night and under the weather for F-15E and F-16C/D fighter aircraft. The threat by the enemy's formidable armored and air forces, especially that of the Warsaw Pact against the North Atlantic Treaty Organization (NATO), has increased in the past few years and is projected to become stronger in both quantitative and qualitative terms. Enemy armor, equipped with night vision and accurate laser ranging systems, has been combined with new hardware, training and operational doctrine to assure a continued thrust during night and adverse weather conditions. Successful interdiction and close air support missions against this threat require low altitude navigation, standoff target acquisition and accurate weapons delivery against small mobile targets as well as fixed targets. LANTIRN provides the capability not only to attack at night, but also to attack with precision laser guided weapons day or night and in conditions of limited visibility.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	39,793	40,103	20,429	N/A	9,944	535,011
Aircraft Procurement	423,900	786,100	790,700	N/A	1,468,300	3,565,000

EXPLANATION: (U) RDT&E: The $2.936 million reduction in FY 1986, the $1.337 million reduction in FY 1987 and the $5.212 million reduction in total estimated cost are due to Gramm-Rudman-Hollings and undistributed Congressional reductions (i.e., inflation, profit policy). Procurement: Includes a new requirement to begin incorporation of an eye safe laser into the LANTIRN targeting pod ($5.0 million increase in FY 1987 and total estimated cost) and a revised initial spares funding profile ($6.6 million increase in FY 1988 and a $8.8 million increase in total estimated cost) to offset Congressional reductions in prior years.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Aircraft Procurement:						
Funds (PE 27249F)	423,900	791,100	797,300	724,700	745,800	3,578,800
Navigation Pods (Qty)	7	143	169	240	139	700
Targeting Pods (Qty)	2	7	81	231	379	700

5. (U) RELATED ACTIVITIES: Aircraft production changes to support LANTIRN/F-16 integration are funded under PE 27133F, F-16 Squadrons. Aircraft production changes to support Low Altitude Navigation and Targeting Infrared System for Night (LANTIRN)/F-15E integration are funded under PE 27130F, F-15 Squadrons.

6. (U) WORK PERFORMED BY: The LANTIRN program office, Aeronautical Systems Division, is located at Wright-Patterson AFB, OH. The LANTIRN prime contractor is Martin Marietta, Orlando, FL. Major subcontractors include Texas Instruments, Dallas, TX, for terrain following radar; Hughes Aircraft Corp., Canoga Park, CA, for missile boresight correlator; Delco Electronics, Milwaukee, WI, for Miltary Standard 1750 pod control computers; Sperry Systems Management, Great Neck, NY, for pod automatic test support equipment; and Grumman Aerospace Corp., Long Island, NY for portions of the radar support equipment. The head-up display prime contractor is Marconi Avionics, Rochester, England. F-16/LANTIRN integration work is being performed by the General Dynamics Corp., Ft. Worth, TX. F-15E/LANTIRN integration work is being performed by the McDonnell Douglas Corp., St. Louis, MO.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2693, Low Altitude Navigation and Targeting Infrared System for Night (LANTIRN)

A. (U) Project Description: LANTIRN will provide a capability for low altitude precision attack during night and in conditions of limited visibility for air-to-surface interdiction and close air support missions. LANTIRN consists of a navigation pod, a targeting pod, and associated integration with aircraft heads-up and heads-down displays.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Completed development flight test and conducted Initial Operational Test and Evaluation of the targeting pod. This led to a positive Air Force Systems Acquisition Review Council (AFSARC) IIIA decision to begin low rate initial production of 2 targeting pods in June 1986. Development of the intermediate level support equipment (SE) continued. LANTIRN system integration on the F-15E aircraft began this year. System integration to

incorporate Auto Terrain Avoidance (ATA) into the F-16 began. Planning for LANTIRN/F-16 Follow-On Test and Evaluation (FOT&E) began.

(2) (U) FY 1987 Program: Low Altitude Navigation and Targeting Infrared System for Night (LANTIRN)/F-15E integration will continue and flight testing will start. ATA integration with the F-16 will continue and F-16/ATA flight testing will begin. LANTIRN/F-16 FOT&E will begin and development of intermediate level SE will be completed. An Air Force Systems Acquisition Review Council (AFSARC) IIIB for the navigation pod was held in October 1986 and approved full rate production of 143 navigation pods and continued production of 7 targeting pods and 6 sets of intermediate level SE. Delivery of the first two production navigation pods will occur this year. An AFSARC IIIB, full rate production decision for the targeting pod is planned for September 1987.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: This project will continue integration and development flight testing of LANTIRN/F-15E and F-16/ATA. Production will continue and buy 169 navigation pods, 81 targeting pods and 12 sets of intermediate level SE. Delivery of the first 2 production targeting pods will occur this year. Cost estimates for this program are Category I, Comprehensive, and result from firm fixed-price production options and independent cost analyses. The latest independent cost review was conducted in September 1986 in support of the AFSARC milestone review.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: This project will complete integration and development flight testing of LANTIRN/F-15E and F-16/ATA and support continued FOT&E to develop night attack tactics and define training requirements. Production will continue and buy 240 navigation pods, 231 targeting pods, and the last 7 sets of intermediate level SE. Navigation pod IOC will be achieved.

(5) (U) Program to Completion: This project will fund completion of support to the FOT&E effort. Production of both navigation and targeting pods and intermediate level SE will continue. The final year for procurement to complete the buy of 700 pod sets is FY 1991.

C. (U) Major Milestones:

	Milestones		Dates
(1) (U)	Basic Contract Award		September 1980
(2) (U)	Critical Design Reviews Completed		June 1982
(3) (U)	Start Navigation Pod Development Test & Evaluation (DT&E) Flight Test		July 1983
(4) (U)	Start Targeting Pod DT&E		October 1983
(5) (U)	Navigation Pod Initial Operational Test & Evaluation (IOT&E) Completed		November 1984
(6) (U)	Navigation Pod Low-Rate Production Decision (AFSARC IIIA)		March 1985
(7) (U)	Targeting Pod IOT&E	*(January-March 1986)	January-April 1986
(8) (U)	Targeting Pod Low-Rate Production Decision (AFSARC IIIA)	*(May 1986)	June 1986
(9) (U)	F-15E Integration Start		April 1986

Milestones		Dates
(10) (U) Navigation Pod Full-Rate Production Decision (AFSARC IIIB)	*(September 1986)	November 1986
(11) (U) F-15E/LANTIRN Flight Test Start	*(January 1987)	December 1986
(12) (U) First Navigation Pod Production Delivery		April 1987
(13) (U) Targeting Pod Full-Rate Production Decision (AFSARC IIIB)		September 1987
(14) (U) First Targeting Pod Production Delivery	*(April 1988)	July 1988
(15) (U) Navigation Pod Initial Operational Capability		FY 1989
(16) (U) Targeting Pod Initial Operational Capability		FY 1990

*Date presented in FY 1987 Descriptive Summary.

(U) Explanation of Milestone Changes

(7) (U) Targeting pod Initial Operational Test and Evaluation (IOT&E) extended 2 weeks due to inclement weather over the test ranges.

(8) (U) Targeting pod low rate initial production (LRIP) decision slipped 2 weeks due to extension of IOT&E.

(10) (U) Navigation pod full rate production decision slipped 6 weeks for administrative reasons. No impact to the program schedule since the contract option was exercised within the December 1, 1986 deadline.

(11) (U) F-15E/LANTIRN flight test start accelerated 1 month to allow additional flight testing.

(14) (U) First targeting pod production delivery moved to July 1988 as a result of the delay in targeting pod production decision from February 1986 to June 1986 to ensure adequate testing was accomplished prior to a production decision.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64250F
DOD Mission Area: 221 - Counterair

Title: Integrated Electronic Warfare/Communications Navigation Identification (EW/CNI) Development
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	0	0	5,714	36,081	Continuing	N/A

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This FY 1988 new start program is an advanced avionics program with specific application to the Advanced Tactical Fighter (ATF) and other low observable platforms. The INEWS, ICNIA program will emphasize a system architecture made up of advanced semi-conductor technology including insertion of Very High Speed Integrated Circuits (VHSIC) into communication, navigation, identification and electronic warfare subsystems. ICNIA, INEWS systems should provide a very high mission reliability, fault tolerant design, reduction in support costs and reduction in aircrew workload in a dense threat environment. The reliability and maintainability will be enhanced through the development of modular packaging techniques, portions of which will be developed for test flights on tactical aircraft.

Further, by integrating INEWS/ICNIA with the offensive avionics package, the pilot's situation awareness and combat capability will be increased.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	0	0	5,835	N/A	Continuing	N/A

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: PE 63109F, INEWS/ICNIA, will provide the support technology base for this program. Also, PE 63226F, DOD common programming language (ADA) Advanced Development and PE 63728F, Advanced Computer Technology will provide ADA software support products. PE 63743F, Electronic Combat Technology interfaces advanced electronic countermeasures techniques. Close coordination with the Defense Advanced Research Projects Administration (DARPA) sponsored Pilot's Associate program is required so expert systems technology can be used to reduce pilot workload. This program element is intended to provide a bridge between finishing advanced development work and starting the ATF FSD effort in 1991.

6. (U) WORK PERFORMED BY: Aeronautical Systems Division at Wright-Patterson Air Force Base, Ohio, is responsible for the INEWS/ICNIA program. Two contractor Joint Venture Teams (TRW/Westinghouse and Sanders/GE) have been selected to

conduct the Phase IB, Demonstration/Validation program for INEWS. The ICNIA advanced development program is contracted to TRW. The government plans to down select to a single team in 4th quarter 1988 through competitive bidding to accomplish this program.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 64250F, Integrated EW/CNI Development

A. Project Description: INEWS is an Air Force led, joint AF/Navy program to develop the next generation airborne defensive avionics system for advanced technology aircraft, specifically the Air Force Advanced Tactical Fighter (ATF) and the Navy Advanced Tactical Aircraft (ATA). ICNIA is a tri-service program to develop the next generation Communication, Navigation, and Identification integrated subsystem for advanced aircraft. INEWS is an integrated defensive system, (integrated with other on-board weapons system) that will enable the host aircraft to perform combat missions while operating in the advanced, multispectral netted threat environment of the 1990's.

The basic requirement is to provide aircrews timely and accurate threat warning and optimum application of countermeasures. ICNIA will provide reliable communication and navigation information to insure mission effectiveness. The response will be tailored to the specific mission requirement and projected threat envonment in near real-time. Effective implementation of INEWS requires a defensive suite fully integrated with other aircraft sensors and avionics through and with an integrated avionics architecture, which includes ICNIA.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Not Applicable

(2) (U) FY 1987 Program: Not Applicable

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: This FY 1988 new start program will emphasize hardware and software design for prime and support systems. Preliminary designs will be validated and traced to the ATF functional specifications and requirement for support systems. The program will enter FY 1988 under a preliminary Full Scale Development (FSD) phase and continue into the year with down selection from two contractor teams to one into FY 1989. Preliminary FSD will encompass contractor initiated preliminary designs of prime equipment, development of interface control documentation, analyses of Common Signal Processor, implementation of an avionics integrity plan, development of support equipment plan for life cycle cost analysis, initial modeling efforts, identification of critical technology risk items, development of design criteria for maintainability and reliability, recommended retrofit options and development of a Test and Evaluation Master Plan.

Program Element: 64250F
DOD Mission Area: 221 - Counterair

Title: Integrated Electronic Warfare/ Communications Navigation Identification (EW/CNI) Development
Budget Activity: 4 - Tactical Programs

(4) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Full Scale Development and tailored platform engineering begins in FY 1989. Ground and flight testing of the integrated system will start in FY 1991.

The EW/CNI system is required to interface with the offensive weapons suite without degrading required mission performance.

(5) (U) Program to Completion: A timely INEWS/ICNIA full scale development decision will be made in order to link this development effort with other subsystem avionics development as well as with the prime ATF production lines.

C. (U) Major Milestones:

Milestones	Dates
(1) Start Preliminary FSD	January 1989
(2) Critical Design Review	November 1990
(3) Begin ATF Full Scale Development	April 1991

9. (U) COOPERATIVE AGREMENTS: Not Applicable

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64268F
DOD Mission Area: 225 - Air Warfare Support

Title: Aircraft Engine Component Improvement Program (CIP)
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		111,515	108,774	101,012	128,737	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Aircraft Engine Component Improvement Program (CIP) provides engineering support to ensure that engines continue to support current missions of host aircraft, reduce cost of ownership, improve system operational readiness (OR) and keep older engines operational. Historically, aircraft systems change missions, tactics and environments to meet changing threats. An objective of CIP is to ensure the engine maintains satisfactory performance under the new conditions. History also shows that an active CIP is an effective way to reduce the cost of engine ownership and to improve system OR through improvements in durability, operability, reliability, repairability, maintainability and suitability as service time accumulates and operational conditions change. A CIP for each engine starts when engine development is complete and the Air Force accepts the first production funded aircraft with the engine. CIP continues over the engine's life but gradually decreases to a minimum level sufficient to keep older inventory engines operational. Typically, this low level CIP effort develops depot repair procedures for older engines. CIP addresses usage and life not covered by engine warranty and enables the Air Force to obtain improved warranties when manufacturers incorporate CIP improvements into production engines. Since changes continue throughout a system's operational life, CIP must be maintained at a level to provide the engineering support to make the engine changes which are essential for satisfactory system performance at costs affordable to the Air Force. The CIP also ensures continued improvements in engine reliability and maintainability factors. This reduces the size of out-year support costs. Typically, CIP efforts reduce Operations and Maintenance costs by a factor greater than fifteen to one. The funds being requested represent Air Force requirements only and do not include funds required from other Services or from Foreign Military Sales.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	121,728	141,776	141,306	N/A	Continuing	N/A

EXPLANATION: (U) Congressional actions reduced both the FY 1986 and the FY 1987 appropriation. FY 1988 funding was reduced to align program funding with planned expenditures, to cover a special Strategic Air Command project and as a result of a reduction in total obligational authority.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: CIP draws requisite technologies from the following programs: PE 63202F, Aircraft Propulsion Subsystem Integration (fan and low pressure turbine); PE 63216F, Advanced Turbine Engine Gas Generator (compressor, combustor, and high pressure turbine); PE 64218F, Engine Model Derivative Program (additional component and engine test data); PE 78011F, Industrial Preparedness Program (materials processing and component fabrication demonstration). Othe rrelated activity includes PE 64209F, F100 Durability, which developed and qualified the Digital Electronic Engine Control and gear type main fuel pump. These developments together with the Increased Life Core provided by CIP formed the basis for the 4000 Total Accumulated Cycles F100-PW-220 engine. The Army and the Navy have Aircraft Engine Component Improvement Programs, PE 64268A and PE 64268N.

6. (U) WORK PERFORMED BY: The Deputy for Propulsion, Aeronautical Systems Division (ASD), Wright-Patterson AFB, OH manages the overall program. Individual engine CIPs are managed by ASD and the Air Force Logistics Command's San Antonio Air Logistics Center and Oklahoma City Air Logistica Center. Arnold Engineering Development Center, Tullahoma, TN and the Air Force Flight Test Center, Edwards AFB, CA conduct in-house test and evaluation efforts. Contractors include Allison Gas Turbine Division of General Motors, Indianapolis, IN (T56, TF41 engines); General Electric Company, Evendale, OH (J79, TF39, F101, F110 engines); General Electric Company, Lynn, MA (J85, J85-21, TF34, T64 and T58 engines); Air Research (Garrett), Torrance, CA and Phoenix, AZ (T76 and gas turbine engines); Pratt and Whitney Aircraft of Canada, Ltd (T400); Pratt and Whitney, Government Products Division, West Palm Beach, FL (J57, J75, F100, TF30, TF33 engines); Solar Turbine Inc, CA (gas turbine engines); Teledyne CAE, Toledo, OH (J69 engine); and Williams International Corporation, Walled Lake, MI (F107 and F112 engines).

7. (U) PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: PE 64268F, Aircraft Engine Component Improvement Program (CIP)

A. (U) Project Description: CIP is required for each operational engine to identify and resolve potential safety of flight problems, cost avoidance and operational problems that arise during service use. In general, CIP for each engine consists of such typical efforts as: (1) analysis and test to identify engine life limiting parts so that corrective actions can be initiated before operational use is impacted; (2) evaluation of new hardware to reduce adverse engine impact on the environment; (3) demonstrations to review or revise maintainability actions to establish and update inspection limits and techniques for field and overhaul activities; (4) investigation of field and test failures to determine their significance and, where appropriate, generate changes on a timely basis to reduce the impact on the aircraft mission; (5) reducing maintenance and spare parts costs by developing, evaluating, qualifying and introducing repair techniques or redesigned parts; and (6) flight and ground testing of engines and components to provide immediate investigation of service revealed discrepancies and to evaluate proposed engineering changes. Return on investment, age, use, quantity of engines and operational experience are factors considered in determining the resources allocated to each of these efforts within a given engine CIP.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: The Aircraft Engine Component Improvement Program provided continuing engineering support for all engines in the Air Force operational inventory. Tasks were specifically directed at reducing and eliminating Class A and B incidents. Life cycle cost (LCC) avoidance of over $2.3 billion was documented in FY 1986 which is a measure of reliability and maintainability (R&M) improvement. The major savings occurred on the F100, F101, TF30, TF34 and TF39 engines. Many repair techniques were developed to avoid depot line stoppages and to provide needed parts to the field.

(2) (U) FY 1987 Program: Engineering effort will be conducted in numerous areas on aircraft engines and related hardware. Service revealed deficiencies will be investigated, defined and corrected. Engine R&M will be improved by enhancing the design of marginal components. Maximum operating time of engines will be extended. Overhaul costs will be reduced by qualifying new wear limits and determining parts life. Problems with engines maintaining required performance will be addressed. Engine maintainability actions will be reviewed. Inspection limits, along with field and overhaul techniques, will be established and updated. Engines will be tested to provide early disclosure of any weakness that would limit engine life. Such weaknesses would normally appear only after extended service operation. Engine maintenance and spare parts costs will be reduced by reviewing, evaluating and introducing repair techniques. Engine inspection intervals will be increased and improved inspection techniques developed. It is estimated that the FY 1987 program will generate over $1.9 billion in LCC avoidance.

(U) The activity above applies to all engines in Air Force inventory to one degree or another. Two high technology engine models (F110 and F100-220) entered the inventory in FY 1986. Engineering support during initial introduction is essential to prevent long term problems impacting mission capability and aircraft availability.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Effort will be conducted on each engine to reduce air aborts, Class A and B incidents, not-mission-capable rates, scheduled and unscheduled engine removal rates, maintenance man-hours, and overall engine cost.

(U) F100 (F-15, F-16): The major technical effort during this period will be directed toward the F100-PW-220 model. Support will be provided to the Automated Ground Engine Test Set program. R&M improvements in the Digital Electronic Engine Control, gearbox, bearings and lube system are planned. Effort on current F100-PW-100 and F100-PW-200 models will decrease while support of the upgraded 4000 cycle core models of these engines increases. Redesigned compressor variable inlet synchronizing ring, improved inlet anti-ice capabilities, high pressure compressor 5th stage disk redesign, improved life for 3-4 stage turbine spacer and anti-rotation of the No. 4 bearing are some of the approximately 50 tasks that will be worked.

(U) F101 (B-1B): During this time period, flight hours will accumulate at an increasing rate with a corresponding increased potential for operational problems. This has been seen on other engines. Extensive testing will be conducted to identify problems before they occur in operation. In order to more accurately predict F101 parts life and

performance retention, the durability of an off-the-shelf production engine will continue to be evaluated. Operational data will be collected and evaluated to improve the effectiveness of the accelerated mission testing and a lead-the-force program will be maintained. Over 38 individual repairs have been identified as top replenishment life cycle cost drivers and they will be worked as time and funds permit. The Engine Structural Integrity Program will be continued. Over 40 tasks have been proposed such as augmentor valve redesign and improved reliability of the mainshaft bearing. These tasks will be worked in order of priority.

(U) F110 (F-16): This new engine is entering the Air Force inventory in a single engine fighter aircraft with initial deployment overseas. Extensive testing is programmed to identify as many potential problems as possible and to verify fixes developed. The technical plan is to address service revealed deficiencies, especially those with safety of flight implications as soon as they arise. The lead-the-force and life management plans will be continued. Several reliability and maintainability projects and repairs are planned.

(U) TF41 (A-7): This engine accumulates about 80,000 engine flight hours (EFH) per year. Work will be done to improve life limited parts to reduce expensive spare parts buys and to correct problems occurring in the field. Major tasks planned are to complete effort on engine air seal improvements, high pressure turbine (HPT) first stage vane single crystal development and application, HPT cast bearing support redesign and low pressure turbine support inner core redesign. Effort will also be expended on life limit extension testing, service repair developments, qualification of alternate approved sources and investigation, analysis and correction of service revealed deficiencies.

(U) TF30 (F-111): This engine accumulates about 200,000 EFH per year. Leading causes for unscheduled removals are compressor damage, oil leakage, compressor stalls, afterburner problems and turbine failures. The leading causes for scheduled removals are low pressure compressor (LPC) stators, high pressure compressor stators, discs and spacers, and turbine nozzle vanes. Tasks planned for this time period include diffuser case repairs, and cast LPC stators. Improved life analysis and accelerated mission tests will also be conducted.

(U) J79 (F-4): The J79 is one of the older but active engines with over 20 million EFH accumulated. The number, usage and age of this engine make it essential to maintain an active engineering support program. Due to the age of the engine, repairs are very important in this program. Planned efforts include improvements to the second and third stage nozzles and the turbine frames and tube to reduce oil leakage, redesign of the turbine shaft and a compressor rotor life update. Oil leaks are the primary cause for engine removals. Afterburner or augmentor problems, turbine frame case cracking, turbine nozzle failures and bleed air malfunctions also contribute significantly to engine removal.

(U) TF39 (C-5): Many reliability, maintainability and durability improvements have been incorporated in this engine to improve the time between overhaul from 1000 hours to 5000 hours. The maintenance plan has been changed to on-condition (i.e., "as needed") maintenance. Over 200 new engines are being procured for the C-5B program. A major thrust for CIP on this engine will be to develop an on-condition-maintenance threshold sampling plan and revise it as engine usage dictates to safely extend useful life of components. The impact on engine life will also be closely monitored when

operating the wing modified aircraft to maximum gross weight take-offs. Some of the tasks currently planned are stage two fan blade interlock improvements, High pressure turbine (HPT) stage one blade redesign, fan tachometer and lead redesign and solution to compressor flange erosion. Several repair tasks are also planned.

(U) TF34 (A-10): This engine accumulates over 200,000 hours per year. There are several safety or potential safety concerns associated with this engine. They are HPT stage 2 disk failures, HPT stage 1 aft cooling plate cracking, low analytical life of the compressor load lock slot and low analytical life of low pressure turbine stage 4 disk. In addition to these safety concerns, effort will be directed toward performance degradation, compressor wear and durability, hot section durability, field problems, repairs and logistics support problems and life management.

(U) T56 (C-130): This is one of the oldest engine designs in service. There are over 8,000 engines in the field and the engine is still in production. The Air Force accumulates about 1.5 million engine flight hours per year. Engine removals are driven by low power or thrust, reduction gearbox failures, oil leakage, engine decouplings, turbine and compressor damage due to material failures and turbine nozzle failures. The technical plan calls for continued evaluation of compressor coatings for improved corrosion and erosion resistance, low cycle fatigue analysis for compressor disks and series I and II turbines, development of solutions to turbine spacer problems, reduction gearbox internal component improvements, service revealed deficiency investigations and development of repair procedures.

(U) CIP efforts for the older engines (J57, J69, J85-8 Stage, TF33, F107, F112, T64, T76 and T400) will concentrate on repairs and other actions necessary to maintain the operation of the fleet. Within CIP, Air Force funding for each of these engines is $2.0 million or less. While this is a low level of funding, it provides the support to keep these systems flying and to avoid depot line stoppages, and will generate approximately $160 million of life cycle cost avoidance.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Effort will be conducted on each engine to reduce air aborts, Class A and B incidents, not-mission-capable rates, scheduled and unscheduled engine removal rates, maintenance man-hours and overall costs.

(U) F100 (F-15, F-16): Re-evaluation of the life of various critical parts will be accomplished based on actual operational experience to reduce logistics surprises and potentially catastrophic failures. Efforts will be directed toward developing repairs for high cost parts in the various models of the F100 engine. The redesign of the compressor variable inlet synchronizing ring and the high pressure compressor fifth stage disk will be completed and tested. There will be approximately 45 individual tasks worked for the F100 engine during this time period in addition to special testing at Arnold Engineering Development Center.

(U) F101 (B-1B): During this time period, operating hours will continue to accumulate at a high rate. The fleet leader program will be identifying operational problems which will require continuing engineering support. Durability of an off-the-shelf production engine will continue to be evaluated along with the improvements introduced in the FY 1987 and FY 1988 time period. Engine Structural Integrity Program discipline will be applied to all new parts

introduced into the engine as well as repaired parts. Individual repairs will be developed as time and funds permit on a priority basis to avoid depot line stoppages and non-availability of engines in the field due to lack of parts. Life cycle cost (LCC) avoidance tasks of over $800 million are planned for this year.

(U) F110 (F-16): This engine will be fully operational by this time period. Extensive testing will continue to identify potential future problems and to verify fixes developed for identified problems. The lead-the-force and life management programs will continue. Since the main application of this engine is in a single engine aircraft stationed overseas, it is essential that fast response to field problems be available to avoid groundings and excessive Class A incidents. The CIP effort will provide the engineering necessary to achieve this support.

(U) TF41 (A-7): This engine will accumulate over 77,500 hours in FY 1989. The lead-the-force and life limit extension programs will continue. Redesign is planned for the forward bypass duct, combustion inner heat shield, low pressure cooling air manifold and outlet guide vane bypass fairing during this period. The low pressure turbine first and second stage turbine blades and wheel redesign should be completed this year. Repair procedures will be developed as required and accelerated mission tests conducted. It is planned to accomplish tasks that will reduce LCC by $75 million.

(U) TF30 (F-111): Over 200,000 engine flight hours are schedule for this engine in FY 1989. The leading cause for unscheduled removals and scheduled removals are listed in the FY 1988 effort. Effort will be continued in this year to correct these problems. Some specific tasks scheduled for this year are improvement of first and second stage vane durability on the P100 model, development of a floatwall design to reduce excessive cracking of the outer duct, and repair of the rear flange flameholder. It is estimated that these improvements will result in over $200 million in LCC avoidance.

(U) J79 (F-4): The Air Force has over 3800 of these engines and is still accumulating around 500,000 engine hours per year. Repairs will continue to be a major emphasis in FY 1989. In addition, some specific tasks such as improvement of the exhaust nozzle primary flap, improvement of the fuel nozzle, coating for the low smoke combustor, turbine sump air flow deflector and re-analysis of third stage turbine disk life will be worked. At least one endurance test will be conducted to validate repairs and improved parts.

(U) TF39 (C-5): Production of the additional engines for the C-5B program should be completed by this time. Effort will be required to continue development of procedures for the on-condition maintenance plan. Data will be available to update parts life based on usage with the increased aircraft capability. This effort will extend over three more years. It is estimated that over $70 million LCC avoidance will be realized in FY 1989 as a result of effort planned in support of this engine.

(U) TF34 (A-10): Performance, oil contamination, and oil leakage are the leading causes for unscheduled removal of this engine. Performance degradation, compressor wear/durability, and hot section durability will be the main areas of work. Repairs, logistics support and life management will continue to be addressed. Over $170 million in life cycle cost (LCC) avoidance was documented in FY 1986. An additional $150 million will be realized as a result of the FY 1989 CIP effort.

(U) T56 (C-130): The effort during FY 1989 will be to complete improvements to the turbine spacer, reduction gearbox internal components and evaluation of compressor coatings. Low cycle fatigue analysis for compressor disks and series I & II turbines will continue. Torquemeter and safety coupling improvements will be developed along with development of repair procedures and service revealed deficiency investigations. Approximately 2270 hours of testing are planned to qualify parts, replacement vendors and repairs.

(U) CIP efforts for the remaining engines (J57, J69, J85-8 Stage, J85-21, TF33, F107, F112, T58, T64, T76, T400 and gas turbine engines) will concentrate on repairs, service revealed problems, and other actions necessary to maintain the operation of the aircraft. The Air Force funding for CIP on these engines is generally $1.5 million or less. While this is a low level of funding, it provides the support to keep these systems flying and to avoid depot line stoppages, and will generate approximately $170 million of LCC avoidance.

(5) (U) Program to Completion: A continuing program is conducted for each in-service engine. The level of funding for each engine program is derived from bottoms-up estimates of development costs required to meet each engine's specific program objectives and is reviewed by the Engine Advisory Group comprised of technical and management specialists from Air Force Logistics Command, Air Force Systems Command and Air Force Wright Aeronautical Laboratories.

C. (U) Major Milestones: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64314F
DOD Mission Area: 221 - Counterair

Title: Advanced Medium Range Air-to-Air Missile (AMRAAM)
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		89,647	36,864	28,194	0	0	894,356
3096	AMRAAM	89,647	36,864	28,194	0	0	894,356

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The US and NATO tactical air forces urgently require a high performance air-to-air missile to help compensate for the numerical advantage of Warsaw Pact fighter/interceptor aircraft. Thus, this joint Air Force/Navy program is structured in response to the Joint Service Operational Requirement and Mission Element Need Statement to significantly improve operational utility and combat effectiveness through development of a follow-on to the AIM-7 SPARROW air-to-air missile. A NATO Staff Target titled "Operational Objective for NATO Air-to-Air Missiles for the 1980s and Beyond" has identified a nearly identical requirement. The need described in these documents is for an all weather, all aspect, all environment air-to-air missile compatible with the F-14, F-15, F-16, F/A-18 and appropriate NATO air superiority and air defense aircraft. The missile must have a launch and maneuver employment capability, a performance envelope significantly improved over the AIM-7F/M, be lightweight, have increased missile velocity and be capable of operating in the 1990s electronics countermeasures environment. The missile must provide the attacking aircraft with the capacity for multiple target attack during a single intercept thus acting as a force multiplier and reducing friendly aircraft attrition in medium range air-to-air engagements. AMRAAM, designated the AIM-120A, will satisfy these needs. AMRAAM Full Scale Development is funded under this program element.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	101,291	39,080	13,013	N/A	0	894,111
Missile Procurement (27163F)	208,989	756,781	1,031,353	N/A	4,868,659	6,967,317

(U) The FY 86 RDT&E reductions resulted from Gramm-Rudman, inflation, small business and other reprogramming actions. Reductions in FY 87 resulted from inflation and small business adjustments. (Note: President's Budget estimate ($37,164) did not include a subsequent $300 thousand reduction for additional small business adjustments.)

to Congress. The total development estimate remains the same as last year [$972.4 million]). The RDT&E increase in FY 88 allows for completion of the development efforts.

- (U) The decrease in FY 86 procurement funds was for an inflation reduction.

- (U) The FY 87 procurement request ($756.781M) was reduced by Congress to go along with the revised FY 87 (180) and FY 88 (630) missile programs. The reduced funds caused some of the peculiar support equipment and training items to be rephased to FY 88.

- (U) The decrease in FY 89 missile quantity was due to concern over the increase in production rate between FY 88 and FY 89. This smoothing of the ramp-up rate was in reaction to FY 87 Congressional actions. The total estimated cost reduction is due to inflation adjustments.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Missile Procurement						
Funds	193,396	582,397	837,006	880,776	4,218,157	6,809,496
Quantities	0*	180	630	1750	14,548	17,108

* 15 qualification missiles will be built by the follower contractor for testing purposes. None of these missiles will be delivered to the Air Force inventory.

5. (U) RELATED ACTIVITIES: The AMRAAM development program is a Joint Service effort with the Air Force as Executive Service and Navy personnel integrated into the Joint System Program Office (JSPO). The Navy has assigned: the Deputy Program Manager, the Assistant Chief Engineer, and various other assistants for logistics, budget, project management, and the test program. The JSPO is maintaining a close relationship with the F-14 (PE 25667N), F-15 (PE 27130F), F-16 (PE 27133F), and F/A-18 (PE 24136N) program offices to assure proper implementation of the aircraft modifications required to employ AMRAAM. The AMRAAM Validation Phase was funded under PE 63370F and PE 63370N. Funding for Navy peculiar Full Scale Development requirements and Operational Evaluation is included in PE 64314N. Air Force procurement of AMRAAM is funded under PE 27163F (3020) beginning in FY 1984, with emphasis on producibility enhancements and second source qualification efforts. Other related programs include target identification and processing techniques.

6. (U) WORK PERFORMED BY: The AMRAAM development and acquisition program is being managed by the AMRAAM JSPO at the Armament Division, Eglin Air Force Base, FL. In addition to the Armament Division, other government organizations/facilities participating in the development effort include the Air Force Armament Laboratory,

Eglin AFB, FL; White Sands Missile Range, NM; Air Force Avionics Laboratory, Wright-Patterson AFB, OH; Air Force Materials Laboratory, Wright-Patterson AFB, OH; Pacific Missile Test Center, Naval Air Station, Pt Mugu, CA; and Naval Weapons Center, China Lake, CA. Hughes Aircraft Company, Canoga Park, CA, was selected as the prime contractor for Full Scale Development (FSD) and as leader for initial production (under a leader-follower concept) of AMRAAM. Raytheon Company, Bedford, MA, was awarded a follower contract to learn about the AMRAAM system from Hughes during FSD and to become the second source competitive producer of AMRAAM.

7. (U) PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR 1989: Not Applicable.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR 1989:

(U) Project: 3096, AMRAAM

A. (U) Project Description: The AMRAAM development effort has the objective of significantly increasing US and NATO air-to-air capability by producing a high performance, reliable missile, with emphasis on engagement and destruction of very low altitude and high altitude/high speed targets in an electronic countermeasures environment. To satisfy the Mission Element Need Statement, Joint Service Operational Requirement, and NATO Staff Target, the proposed AMRAAM design utilizes various guidance modes which include inertial midcourse guidance (can be updated in flight) and active radar terminal guidance. Key features which will improve operational utility of the missile include: capability for multiple target attack by the aircraft, launch and maneuver capabilities, high average missile velocity, improved missile envelope over the AIM-7 SPARROW, and increased maneuverability. Mature technologies, such as solid state electronics, high rate digital computers, and terminal guidance-aided fuzing are featured. Of prime importance is the requirement for the AMRAAM to be compatible with the fire/weapons control systems of the F-14, F-15, F-16, and F/A-18. Germany plans to employ AMRAAM on the F-4F, and the United Kingdom on the Tornado F2 and the Sea Harrier. Two contractors were selected for a competitive Validation Phase beginning in February 1979. Hughes Aircraft Company of Canoga Park, CA, was awarded a contract in December 1981 for the Full Scale Development (FSD) of the AMRAAM system. Rail launchers have been developed by Hughes to provide the necessary aircraft/missile interfaces and will be capable of AMRAAM and AIM-9 SIDEWINDER carriage without modification. They are currently in production. Current SPARROW ejection launchers will be modified under the auspices of the aircraft program offices so that they have both an AMRAAM and a SPARROW capability.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Development Test and Evaluation/Initial Operational Test and Evaluation (DT&E/IOT&E) on the F-16 and F-15 and DT&E on the F/A-18 and F-14 continued in FY 1986 with a success rate by far the best ever maintained by a complex air-to-air missile. The Captive Carry Reliability Program for the F-16 (an "on-airplane" carriage of missiles and launchers to determine reliability as a function of flight time) began in FY 1986. The Test, Analyze and Fix Program, which tests missiles in an environmental test chamber to determine and fix reliability problems, began in FY 1986. The FY 1987 Congressional action permits the addition of new efforts to the previously caped FSD contract ($556,580,480) in order to assure Congress that adequate test results will be available.

Emphasis was placed on reducing AMRAAM production costs through the producibility enhancement program, simplifying missile design, and acceleration of follower qualification to obtain the earliest possible competition. These producibility projects began in FY 1986 as part of the plan to reap savings from these projects starting in Lots II through IV. The contract to initiate Raytheon production qualification was awarded in November 1985. The advance buy and long lead decision for Lot I occurred in July 1986. Navy participation expanded with simulation hardware, reliability demonstrations, and F/A-18 launches being accomplished at Pacific Missile Test Center.

(2) (U) FY 1987 Program: Development Test and Evaluation/Initial Operational Test and Evaluation (DT&E/IOT&E) on the F-16 and F-15, and DT&E on the F/A-18 and F-14 will continue in FY 1987. The Test, Analyze and Fix Program will continue in FY 1987. The F-15 Captive Carry Reliability Program (CCRP) will begin in FY 1987 and the F-16 CCRP will be completed. Producibility projects will continue in FY 1987. The Lot I low rate initial production go-ahead is planned for April 1987. The Lot I quantity of 180 missiles will be split between Hughes and Raytheon.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Full Scale Development (FSD) funding is required in FY 1988 for government support activities (including flight tests). This will complete FSD within the total development budget as approved in FY 87. Low rate production will continue in FY 1988 with the Lot II buy also split between Hughes and Raytheon. Completion of the initial lower cost production designs from the producibility projects will be introduced into the Lot II missiles. Full competition begins with Lot III. The production program is based on a buy of 17,108 missiles for the Air Force and 7,212 missiles for the Navy extending through 1996. Congress established a $7.0 Billion (FY 1984 dollars) cost cap for 24,000 missiles. The cap may be adjusted to reflect Congressional changes.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 Request: Not Applicable.

(5) (U) Program to Completion: FSD is completed in FY 1988; however, this is a continuing production program with the last year of procurement planned for FY 1996. FY 1989 will be the first year of rate production.

C. (U) Major Milestones:

	Milestones	Dates
(1)	(U) Start Design Definition	October 1976
(2)	(U) Complete Design Definition	May 1977
(3)	(U) Start Pre-prototype Evaluations	July 1978
(4)	(U) Complete Pre-prototype Evaluations	September 1978
(5)	(U) Milestone I	November 1978
(6)	(U) Award Validation Phase Contracts	February 1979
(7)	(U) Validation Phase Complete	November 1981
(8)	(U) Award FSD Contract	December 1981
(9)	(U) FSD Subsystem Tests Start	May 1982

(10) (U)	Preliminary Design Review		August 1982
(11) (U)	Milestone II		September 1982
(12) (U)	FSD Flight Tests Start (Missile Free Flight)		December 1984
(13) (U)	Milestone IIIA		3rd Quarter FY 1987
(14) (U)	FSD Flight Tests End	(April 1988)	August 1988
(15) (U)	First Production Delivery	(3rd Quarter FY 1988)	4th Quarter FY 1988
(16) (U)	Milestone IIIB		3rd Quarter FY 1989
(17) (U)	Initial Operational Capability	(3rd Quarter FY 1989)	1st Quarter FY 1990

(U) Explanation of Milestone Changes:

(14) (U) The Full Scale Development test completion date reflects the impact of not being able to initiate a third test location in FY 1986 due to the FSD contract funding cap. The FY 1987 Congressional actions now allow for the third test site.

(15 and 17) (U) The First Production Delivery and Initial Operational Capability dates reflect the impacts of the Congressional changes to the FY 1987 production program. These changes, which required repricing of Lot I due to quantity changes (Lot I was reduced from 260 to 180), delayed the start of production by about four months.

9. (U) COOPERATIVE AGREEMENTS: AMRAAM was designated by OSD as one of the programs under the "Family of Weapons" concept between the US and principal NATO Allies. It was formalized by an Air-to-Air Family of Weapons Memorandum of Understanding (MOU) between the United States, United Kingdom (UK), Germany (GE) and France (France later chose not to participate in missile development, but remains a signatory). Under the terms of the MOU, the US would develop (all development efforts are fully funded by the US) AMRAAM and the UK/GE have the right to buy, assemble, or dual produce AMRAAM. UK/GE are to develop (and fully fund the development) the Advanced Short Range Air-to-Air Missile (ASRAAM) and the US will have reciprocal rights to buy, assemble, or dual produce ASRAAM. The MOU was signed in August 1980.

Budget Activity: 4. Tactical Programs
Program Element: 64314F, Advanced Medium Range Air-to-Air Missile (AMRAAM)

Test and Evaluation Data

1. (U) Development Test and Evaluation (DT&E): Development of AMRAAM is being managed by the AMRAAM Joint System Program Office (JSPO) at Eglin AFB, FL, under the command of the Armament Division, Air Force Systems Command. The 3246th Test Wing at the Armament Division is the Responsible Test Organization (RTO) for DT&E. The Test Wing formed a Joint Air Force/Navy Test Force to conduct the combined DT&E and Initial Operational Test and Evaluation (IOT&E). The Air Force Operational Test and Evaluation Center (AFOTEC) will have overall management responsibility for separate AMRAAM IOT&E and the dedicated OT&E events scheduled during the combined DT&E/IOT&E phase.

(U) Following the completion of concept definition and Milestone I (November 1978), contracts were awarded to Hughes and Raytheon on 2 February 1979 for the competitive Validation Phase. In early fiscal year 1982, Hughes was selected to begin Full Scale Development (FSD). Milestone II was held in September 1982, after completion of the System Preliminary Design Review.

(U) Validation Phase test and evaluation was initiated early in fiscal year 1980 and included a variety of ground, captive carry, and freeflight testing intended to provide data necessary for management to confirm that the AMRAAM concept was sound and that the technical risks in proceeding with FSD were acceptable. To facilitate the validation testing, each of the competing contractors developed their own missile design and fabricated hardware which matured in design from early checkout vehicles to prototype AMRAAMs.

(U) During validation, data were collected to aid the design, prove the weapons system concepts, and support answers to the critical issues. The test hardware used during the Validation Phase was functionally the same as that planned for full FSD; however, the transmitter design was changed from solid-state to a Traveling Wave Tube (TWT). The change reduces technical risk since the AMRAAM TWT is an adaptation of a TWT used in existing electronic warfare equipment. In addition, TWTs in an AMRAAM configuration were laboratory tested by Hughes during validation. Design changes during FSD will result in lower cost, increased producibility, and improved reliability. The FSD plan calls for 90 missile firings to accomplish combined Development and Initial Operational Test and Evaluation of AMRAAM using the F-14, F-15, F-16, and F/A-18 aircraft. Four of these missiles will have live warheads. Captive Carry vehicles will be used similarly to those used during the Validation Phase. In addition, four missiles will be produced for laboratory reliability testing and seven firing assets will be used for a concentrated Captive Carry Reliability Program on the F-16 and F-15.

(U) In-depth Full Scale Development (FSD) was initiated in December 1981. FSD testing accomplished to date includes aircraft/missile environmental and ground testing, the continuation of flight testing AMRAAM hardware, and further progress in weapon system integration tests ensuring aircraft/missile compatibility.

Budget Activity: 4. Tactical Programs
Program Element: 64314F. Advanced Medium Range Air-to-Air Missile (AMRAAM)

(U) The environmental tests demonstrated carriage of single and multiloaded AMRAAM's throughout the operating envelopes of the F-15, F-16, and F/A-18 aircraft. The tests determined the effects of vibration, shock, acoustic, and thermal environments on the missile and launcher, measured the AMRAAM loads during captive flights and determined launch conditions to allow definition of launch platform alignment error budgets.

(U) FSD flight testing phase includes captive flight tests using the AMRAAM Captive Equipment (ACE) and free flight tests using Jettison Test Vehicles (JTV), Separation/Control Test Vehicles (S/CTV), and the Guided Test Vehicles - AMRAAM Air Vehicles Instrumented (AAVI). The ACE vehicles are used to evaluate AMRAAM hardware and software capabilities. Stage one evaluation utilizing the ACE (which included initial AMRAAM software configuration, basic missile guidance and control, and preliminary missile radar capability evaluation) was successfully completed. Stage two ACE evaluation (which included expanded missile radar capability, data link, upgraded built-in test and fuze evaluation) is complete. The ACE was also used to verify the live firings launch profiles.

(U) Live firings accomplished to date include two S/CTV launches and nineteen AAVI launches. The S/CTV launches satisfactorily demonstrated missile aerodynamic performance, safe separation, and airborne/autopilot response and stability. The completed AAVI launches have successfully demonstrated safe separation from and interface with the F-15, F-16, F/A-18 aircraft, and has demonstrated all three AMRAAM guidance and launch modes (command data link, inertial and active). Target intercepts have been demonstrated in high closing velocity, tail-on aspect to opening velocity, tail aspect encounter in a look-down/shoot-down, high clutter environment over both land and water. In addition, intercepts have been successfully demonstrated against targets traversing the beam, in a near beam clutter environment and in an ECM/chaff environment. Missile launches were completed from maneuvering launch aircraft against initial, midcourse and terminal, high maneuvering targets. Also demonstrated were: missile maximum range; rail eject launch modes; track-while-scan launch ability; simulated multiple launch against two targets; and medium pulse repetition frequency, seeker target acquisition and track capability in a clutter environment.

(U) Future free flight testing will include continued captive flight evaluation of AMRAAM hardware and software capability and launch profile verification. Free flight tests will continue by using the remaining 73 AAVI missiles to evaluate missile performance, six S/CTVs for safe separation/missile airframe performance evaluation and eight JTVs for safe jettison evaluation.

(U) Brigadier General Thomas R. Ferguson is the Air Force Program Manager for AMRAAM. The leader contractor is Hughes Aircraft Company and the follower contractor is Raytheon Company.

2. (U) Operational Test and Evaluation (OT&E): AMRAAM Initial operational test and evaluation (IOT&E) began 1 October 85 with the start of the Captive Carry Reliability Program Phase II (CCRP II). AFOTEC is conducting the AMRAAM IOT&E which is the operational portion of the AMRAAM FSD testing and is scheduled to complete tests in January 1989. The IOT&E objectives will be met using data from DT&E and IOT&E tests, including: mathematical modeling and simulations; maintainability demonstrations; three phases of CCRP; AMRAAM Captive Equipment (ACE) missions; and live missile

firings. All phases of testing are ongoing. The modeling/simulation effort and maintainability demonstrations have been conducted since the beginning of FSD. The second phase of the CCRP is a combined DT&E/IOT&E effort due to be completed in March 1987. CCRP III (a separate IOT&E evaluation) will be conducted from January 1987 until January 1989. The IOT&E AMRAAM ACE missions began in October 1986 as part of the preparation for the first IOT&E live firing. The ACE evaluations will support the live fire phase throughout the test program but additionally will provide evaluation opportunity above and beyond the live fire program. The combined live fire portion of the evaluation began in 1984 and will continue until January 1989.

(U) The CCRP will provide reliability and maintainability data for the AMRAAM and the associated carrying and launching equipment. The Modular Rail Launcher (MRL) is designed for use on the F-15, F-16, F/A-18, and F-14. The MRL replaces the launcher currently used for the AIM-9 series heat-seeker missile and is compatible with both the AIM-9 and AMRAAM. CCRP II is the second phase of the captive carry program and is a combined DT&E/IOT&E effort. The program involves captive carriage of AIM-9 and AMRAAM missiles on the F-16 MRL by the 57th Fighter Weapons Wing (FWW) at Nellis AFB NV and at Det 1, 57th FWW, Luke AFB AZ. The reliability of the AMRAAM built-in-test (BIT) is one of the primary objectives of the CCRP, therefore these aircraft are AMRAAM BIT capable. The test team plans to accumulate 800 hours captive carriage time on AMRAAM vehicles and 500 hours on the AIM-9 missile during CCRP II.

(U) The ACE program will provide verification of the planned live launch scenarios and provide effectiveness data in scenarios not planned or possible in the live fire program. The ACE vehicle is an equipment pod carried by the launch aircraft like an actual missile. The pod contains the radar, guidance and control systems of the AMRAAM along with recording and telemetry gear. The aircraft carrying the pod flies through an intercept of a target to record the responses and actions of the actively transmitting AMRAAM equipment contained in the pod.

(U) The USAF IOT&E will fire 25 of the 90 scheduled FSD live AMRAAM launches between October 1986 and late 1988. (The Navy operational evaluation will be conducted by the Navy post FSD. The FSD testing involving F-14 and F-18 aircraft is developmental in nature.) The IOT&E launch scenarios are challenging and thoroughly explore the stated critical issues and the OT&E objectives. Missile launches at both White Sands Missile Range and at the Eglin Gulf Test Range will employ multiple targets, Electronic Counter Measures, maneuvering targets, all aspect targets, various size/type targets, and targets at various altitudes. A tactical telemetry and flight termination system package is being developed to allow collection of full data from any warhead missile launches. The AMRAAM program development strategy involves implementation of five progressive versions of AMRAAM software/hardware, each building on the previous version and increasing in complexity and capability.

(U) The AMRAAM IOT&E test team is attached to Det 2, AFOTEC, Eglin AFB FL, and interacts on a regular basis with the Joint System Program Office also located at Eglin. The IOT&E test team members are integral parts of the AMRAAM Joint Test Force (JTF) who are conducting the DT&E and IOT&E tests during AMRAAM FSD. The primary testing facilities include the Eglin Gulf Test Range FL, White Sands Missile Range NM, Pacific Missile Test Center CA, Nellis AFB NV, and Luke AFB AZ.

Budget Activity: 4. Tactical Programs
Program Element: 64314F. Advanced Medium Range Air-to-Air Missile (AMRAAM)

(U) The plans and reports submitted to date are: AMRAAM Operational Utility Evaluation (OUE) Report - August 1982; and the AMRAAM IOT&E Plan - November 1985.

3. (U) System Characteristics: The missile is being defined in response to the Mission Element Need Statement, Joint Statement of Operational Requirements, and the Operational Objective for NATO Air-to-Air Missiles for the 1980s and Beyond. The objectives data listed below are tentative and reflect JSOR, system specification, and the Secretary of Defense Decision Memorandum thresholds. Demonstrated data reflects what has been accomplished to date and does not necessarly reflect the final values.

Characteristics	Goals/Threshold	Demonstrated
a. Performance		
Speed (maximum Mach)		Demonstrated
Altitude (feet)		
Maximum		To be demonstrated
Minimum		To be demonstrated
Range (nautical miles)		
Maximum		Demonstrated
Minimum		To be demonstrated
Kill Probability (percent)		To be demonstrated
b. (U) Reliability		
Mean Time Between Maintenance (hours)	600/450	To be demonstrated
Operational Reliability (Free Flight)	.9/.85	To be demonstrated
c. (U) Missile Description		
Launch Weight (pounds)	335	Demonstrated
Guidance Type	Active radar terminal/inertial midcourse	Demonstrated
Compatibility	F-14, F-15, F-16, F/A-18, F-4F (German), Tornado (British), Sea Harrier (British)	F-15, F-16, F/A-18 (not all stations)

4. (U) Current Test and Evaluation (T&E):

T&E Activity (Past 12 Months)

Event	Planned Date	Actual Date	Remarks
AMRAAM Air Vehicle Instrumented (AAVI)Launches (FY 86)	25 January 1986	25 March 1986	15 launches
OSD Program Review	June 1986	25 July 1986	
First OT&E Live Fire	July 1986	24 October 1986	
F-16/AMRAAM Captive Carry Reliability Program	March 1986	March 1986	Evaluation of operation - 800 hours planned
AAVI Launch From F/A-18 Begin	February 1986	2 June 1986	Launch fully guided missiles against unmanned targets
HAVE NOTE	August 1986	August 1986	Characterizes AMRAAM free flight susceptibility to electromagnetic threats

T&E Activity (Next 12 Months)

Event	Planned Date	Remarks
Complete GAO report on AMRAAM	March/April 1987	Evaluation of the Test Program
Complete multi-shot against two targets in ECM	March 1987	
Complete Milestone IIIA	April 1987	Low Rate initial production decision
Continue live firings	1987-1988	Thirteen IOT&E launches scheduled between 1st Quarter 1987-1st Quarter 1988

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64315F
DOD Mission Area: 221 - Counterair

Title: Advanced Short Range Air-to-Air Missile (ASRAAM)
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		0	0	3,001	9,576	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Advanced Short Range Air-to-Air Missile is planned to be the next generation short range missile to meet the Soviet threat of the 1990s. The requirement for ASRAAM is documented in the validated Trilateral Operational Requirement for Advanced Short Range Air-to-Air Missile for the 1990s (USAF Statement of Operational Need 16-82). Technical capabilities for the foreseeable future show that complementary short and medium range air-to-air missiles provide the greatest potential for fulfilling the need for future air-to-air missile systems. Under the terms of the Family of Advanced Air-to-Air Missile Systems Memorandum of Understanding, the United States is developing the Advanced Medium Range Air-to-Air Missile (AMRAAM) and the European governments (Germany, Norway, and the United Kingdom) are developing ASRAAM. A U.S. ASRAAM procurement decision will be made after a complete review of missile cost, schedule, performance, reliability and maintainability. F-15/16 test aircraft integration, a limited Development Test and Evaluation, and Initial Operational Test and Evaluation will be required in support of a production decision if ASRAAM proceeds as planned. The Project Definition phase began in February 1985 and will continue through 1988. The Engineering Development phase is scheduled to begin in January 1989, although Europe will be commencing full development of several subsystems in 1987 and 1988. Production deliveries are expected in the mid-1990s. Definitive European contractor estimates are not yet available for missile system costs.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	0	386	865	N/A	Continuing	N/A

EXPLANATION: (U)

- Congress denied funds in FY 1987. This is an FY 1988 restart.

- The major increase in FY 1988 funding results from Air Force providing the necessary funds to accomplish required aircraft integration efforts, engineering analysis, modeling simulation and initial integration hardware (procured from the European contractor).

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: ASRAAM is related to the AIM-9L/M Sidewinder (PE 27161F). The Sidewinder will continue to be a vital element of our short range air-to-air capability in the 1990s and will continue in the inventory through the year 2000. ASRAAM is planned to be the follow-on missile to the AIM-9 in the mid-1990s. Procurement funding for ASRAAM production is being placed in PE 27161F. The Advanced Medium Range Air-to-Air Missile (AMRAAM) (PE 64314F) is also related to ASRAAM. AMRAAM is the U.S. contribution to the Family of Advanced Air-to-Air Missile Systems under the terms of the Memorandum of Understanding (MOU).

6. (U) WORK PERFORMED BY: ASRAAM prime contractor is Bodenseewerk Geraetetechnik British Aerospace GmbH (BBG), a joint GE/UK consortium with headquarters in Ueberlingen, GE. Principal subcontractors include British Aerospace Dynamics Group, Hatfield, UK (missile electronics, structure, integration, aerodynamics, aerostructures and thermodynamics); Bodenseewerk Geraetetechnik, GE (seeker, sensor); Raufoss, Norway (rocket motor); Garrett Manufacturing Ltd, Canada (aerodynamic flight control, activation); Messerschmitt-Boelkow-Blohm, GE (warhead); Junghaus, GE (safe and arm unit and contact fuze); and Thorn EMI Electronics, UK (proximity fuze).

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 64315F, Advanced Short Range Air-to-Air Missile

A. (U) Project Description: ASRAAM is needed to outshoot threat aircraft equipped with weapons equivalent to AIM-9L/M Sidewinder. As an eventual replacement for the Sidewinder, ASRAAM is optimized for close in combat where all aspect, high velocity, high maneuverability, off-boresight capability, and seeker acquisition and tracking are critical performance requirements. The USAF will continue to fund an ASRAAM program office at Eglin AFB with representatives in the European ASRAAM Joint Project Office (AJPO).

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Not Applicable.

(2) (U) FY 1987 Program: Not Applicable.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The FY 1988 planned program funds the establishment and activities of a U.S. program office and U.S. representation at the AJPO in Koblenz, Germany, to insure continuous liaison in the missile development effort. The MOU contains specific provisions for such representation. Program office representatives will assess ASRAAM technical and performance data. In accordance with the MOU, they will be consulted by the European program manager on proposed changes to missile specifications and assess resulting effects on U.S. launch aircraft systems' engineering, cost, performance, and any attendant technical constraints. Other activities include engineering, simulation and analytical support, as well as missile/aircraft integration and compatibility verification. Funding will initiate test aircraft Class II modification efforts (F-15

and F-16), procure various missile test vehicles and equipment (fit, captive, and environmental vehicles, associated loader adapters), and fund test engineering/analyses. Cost estimates, based on historical data for program office personnel and initial estimates from the European AJPO, were reviewed in October 1986 (Cost Estimating Category IV).

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The FY 1989 planned program increases test engineering and analyses. Continuation of the Class II test aircraft modifications will be funded. The development of missile test set/special test equipment will commence, as well as limited range support/data reduction. Seeker test vehicles and guided test vehicles will be procured to support a limited Development Test and Evaluation, while additional captive test vehicles will be needed for subsequent Initial Operational Test and Evaluation (IOT&E).

(5) (U) Program to Completion: This is a continuing program. Program office representation is required throughout the ASRAAM development and procurement cycles. F-15 and F-16 test aircraft modification will continue. A limited number of ASRAAM rounds will be needed for IOT&E. Integration work on Air Force aircraft (F-15 and F-16) and Navy aircraft (F-14 and F/A-18) and subsequent IOT&E/Operational Evaluation will be coordinated to avoid duplication and minimize costs. The procurement decision for ASRAAM will be made after an evaluation of cost, schedule and performance.

C. (U) Major Milestones:

Milestones		Dates
(1) (U) Project Definition Phase		February 1985
(2) (U) Project Definition Extended		February 1987
(3) (U) Project Definition Amendment		October 1987
(4) (U) Engineering Development Phase	*(February 1987)	January 1989
(5) (U) Production Deliveries		Mid-1990s

*Date presented in FY 1987 Descriptive Summary.

(U) Explanation of Milestone Changes

(2) and (3) (U) The Project Definition (PD) phase has been extended through 1988. The initial extension goes to October 1987 and will be performed by the prime contractor at no additional cost to the European developing governments. A PD amendment phase has been added, delaying the start of Engineering Development until early 1989. Although numerous full development activities will be conducted during this amendment phase, some work necessary to proceed into formal Engineering Development will not yet be accomplished.

(4) (U) Start of Engineering Development phase slipped by European ASRAAM Joint Project Office due to extensive review of the missile launch concept and rocket motor redesign due to weight growth.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: The Family of Advanced Air-to-Air Missile Systems Memorandum of Understanding (MOU) was signed by the Republic of France, the Federal Republic of Germany, the United Kingdom and the United States in August 1980. (France chose not to participate in the ASRAAM development program and is pursuing an alternative missile system.) Under the MOU, Europe will develop the ASRAAM system and the U.S. will develop the Advanced Medium Range Air-to-Air Missile (AMRAAM). The intent of this cooperative family of weapons program is to conserve resources by avoiding duplication of development costs, provide options for dual-production, and increase NATO standardization and interoperability. The Kingdom of Norway joined Germany and the United Kingdom for ASRAAM development in December, 1984. Other NATO countries are considering whether or not to join the ASRAAM program. A list of major European ASRAAM contractors is found in paragraph 6. Total European ASRAAM program funding cannot be definitively stated. The costs of the Prefeasibility/Feasibility phases (1979-1983) have been estimated at Deutsche Mark (DM) 18 million. The current Project Definition (PD) phase (1983-1987, up to the PD Amendment portion) is estimated to cost DM 275 million, while the Engineering Development costs are estimated at DM 612 million.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64321F Title: Joint Tactical Fusion Program (JTFP)
DOD Mission Area: 322 - TIARA for Tactical Land Warfare Budget Activity: 4 - Tactical Programs

1. RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	26,034	24,422	[	]	Continuing	N/A

Air Force funding is based on a 12.8% share of RDT&E cost.

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The JTFP is developing the Army All Source Analysis System (ASAS) and the Air Force Enemy Situation Correlation Element (ENSCE) to rapidly receive, correlate, store, display and disseminate enemy target data from a large number of near-real-time (NRT), multi-discipline sensors. This data will be used in the battle management process by both the Air and Ground Commanders and their staffs. The needs expressed in Tactical Air Force (TAF) Statement of Need (SON) 319-82 (validated) will be fulfilled by the ENSCE. The needs expressed in Strategic Air Command (SAC) SON 20-81 (validated) may be satisfied with selected ENSCE software. Air Force requirements are for [ ] ENSCE systems and associated software. One system will be procured in RDT&E. Additionally, software for TAF Headquarters host intelligence computers will be procured.

3. COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	23,720	24,661	[ ]	N/A	Continuing	N/A

EXPLANATION: (U) FY 86 increase was the result of an Air Force reprogramming action.

4. OTHER APPROPRIATION FUNDS: ($ in thousands)

Other Procurement (PE 27431F):						
Funds	0	0	0	[ ]	[ ]	[ ]
Quantities	0	0	0	[1]	[ ]	[ ]

5. (U) RELATED ACTIVITIES: The Army is the Executive Agent for this Joint Program. The program is conducted in accordance with the following documents: US Army, Letter of Instruction (LOI) for JTFP Special Task Force (STF), dated 5 July 1984; Chiefs of Staff Army and Air Force Memorandum for Chairman Joint Chiefs of Staff, Subject: Airland Battle Programs, dated 30 June 1983; and Air Force Program Management Directive 9087 (6)/64321F/27431F, dated 5 May 1986. Relationships between the Air Staff; Air Force Systems Command (AFSC), the Implementing Command; Tactical Air Command,

the Operating Command; and the Joint Program Management Office are continuous. Related Program Elements include: 63260F, Intelligence Advanced Development; 27431F, Tactical Air Intelligence Systems; and 64321A, Joint Tactical Fusion Program (JTFP).

6. (U) WORK PERFORMED BY: The Jet Propulsion Laboratory (JPL), California Institute of Technology, Passdena, California is the systems integration contractor for the JTFP. Subcontractors include: TRW, McLean VA; McDonnell Douglas, Huntington Beach, CA; HRB Singer, State College, PA; Ford Aerospace Corp, Palo Alto CA; Martin Marietta, Denver, CO; Analytics, McLean VA; and MITRE Corp, Bedford, MA. AFSC/Electronic Systems Division is the Air Force in-house developing organization responsible for the Air Force segment of the JTFP.

7. (U) PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 64321F, Joint Tactical Fusion Program (JTFP)

A. (U) Project Description: Develop the Air Force Enemy Situation Correlation Element (ENSCE) to rapidly receive, correlate, store, display and disseminate enemy target data from a large number of near-real-time (NRT), multi-discipline sensors.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: The design of the Intelligence Data Processor (IDP) and Communications Processor and Interface (CPI) modules commenced. They are the heart of the All Source Analysis System (ASAS) and ENSCE at the Corps and Tactical Air Control Center levels, where the Air Land Battle is directed. The Portable ASAS/ENSCE Workstation (PAWS) Preliminary Design Review (PDR) was completed in February and the Critical Design Review (CDR) was completed in September. A PDR of the entire program was conducted in November and a CDR of the ASAS/ENSCE initial system software release was held in April. A CDP for the All Source Processing software for United States Air Force Europe (USAFE) and Pacific Air Force (PACAF) host intelligence computers was completed in September. The ASAS/ENSCE Interface Module (AIM) development was also completed.

(2) (U) FY 1987 Program: FY 1987 funds provide for continued development of the IDP and CPI modules as well as a PDR and CDR for them. Delivery, testing, and evaluation of the PAWS and AIM will occur and the first of two USAFE/PACAF software releases will be delivered. Coding, checkout and test of the ASAS/ENSCE initial software delivery will continue. A PDR of the ASAS/ENSCE second and third software release will also be conducted and detailed design, leading to a CDR for a follow-on release of USAFE/PACAF All Source Processing software will also be performed.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Detailed design of the Intelligence Data Processor (IDP) and the Communications Processor and Interface (CPI) modules will be concluded and hardware assembly integration and test initiated. Initial system software will be delivered along with a second release of

Program Element: 64321F Title: Joint Tactical Fusion Program (JTFP)
DOD Mission Area: 322 - TIARA for Tactical Land Warfare Budget Activity: 4 - Tactical Programs

United States Air Force Europe (USAFE)/Pacific Air Force (PACAF) software. Detailed design, coding, integration and test of the second and third All Source Analysis System (ASAS)/Enemy Situation Correlation Element (ENSCE) software release will continue and a Preliminary Design Review (PDR) for the fourth ASAS/ENSCE software release is scheduled. In addition, delivery of equipment to the joint Army/Air Force training center will begin. Cost estimates are Category II, Mature, based on firm contractor prices and engineering estimates made in June 1986. The costs are based on competitive multi-year procurement. This program is in the full scale development phase.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Two RDT&E ASAS's will be delivered to the Army and an RDT&E ENSCE will be delivered to the Air Force. These systems will then undergo operational testing. In addition, the second and third ASAS/ENSCE software releases will be delivered and a Critical Design Review (CDR) of the fourth software release will occur. A PDR of the fifth software release is also planned. Operator and maintainer training at the joint Army/Air Force training center is also scheduled to begin.

(5) Program to Completion: Results of operational testing will be reviewed and a production decision will be made. The RDT&E system will be upgraded to the objective configuration and [ ] additional objective systems will be procured. Software releases four and five will also be delivered. Selected software modules will be procured for Tactical Air Force (TAF) HQs host intelligence computers and may be procured for Strategic Air Command (SAC) to fulfill the requirements of SAC SON 20-81. This is a continuing program.

C. (U) Major Milestones:

		Milestones		Dates
(1)	(U)	Joint Program Charter signed by the Sec Air Force and Army		February 1982
(2)	(U)	SAC SON 20-81 (Validated)		October 1982
(3)	(U)	Limited Operational Capability Europe		December 1982
(4)	(U)	Congressional Direction and Approval		February 1983
(5)	(U)	TAF SON 319-82 (Validated)		May 1984
(6)	(U)	Preliminary Design Review		November 1985
(7)	(U)	Limited ENSCE, 9th Tactical Intelligence Squadron		January 1986
(8)	(U)	First Delivery of USAFE/PACAF Host Intelligence Computer Software	*(1st Quarter FY 1987)	4th Quarter FY 1987
(9)	(U)	Air Force RDT&E System Test	*(2nd Quarter FY 1989)	3rd Quarter FY 1989
(10)	( )	Air Force Initial Operational Capability		
(11)	( )	Air Force Production System Delivery		

* Date presented in FY 1987 Descriptive Summary

(U) Explanation of Milestone Changes:

(U) (8, 9, 10, and 11) Schedule adjustment due to program restructuring

9. (U) COOPERATIVE AGREEMENTS: There are no specific cooperative agreements regarding the JTFP, no signed documents exist and no foreign funds are provided to the program office. However, the JTFP is an integral part of the Battlefield Information Collection and Exploitation System (BICES). The JTFP is currently supporting BICES Concept and Design Studies (CADS) with the Limited Operational Capability Europe (LOCE) system. The LOCE system is a limited capability Enemy Situation Correlation Element (ENSCE). LOCE terminals are currently on loan to the 1st British Corps and the 1st German Corps in support of BICES CADS. In addition, the Canadians have displayed an interest in using LOCE terminals. Since LOCE is the only intelligence fusion system in the European theater, it is serving as a theater tool to define fusion requirements.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64327F   Title: Hardened Target Munitions (HTM)
DOD Mission Area: 223 - Close Air Support and Interdiction   Budget Activity: 4 - Tactical Programs

1. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		0	0	7,690	14,085	89,320	111,095
3273	I-2000 P^3I	N/A	N/A	7,690	14,085	0	0
3311	Boosted Penetrator	0	0	0	0	89,320	89,320

* Project 3273 tasks were formerly being accomplished exclusively under PE 64602F. In FY 89, any remaining tasks not completed in PE64602F will be transferred to this Program Element.

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Recent Soviet efforts have resulted in a hardened target set that is growing in number. This critical set includes command and control bunkers, hardened aircraft shelters, and underground weapons and fuel storage facilities. Current MK-84 series general purpose bombs suffer from case failure, low order detonation, and ricochet when used against this vital target spectrum. The HAVE VOID/I-2000 warhead (an improved 2000-lb warhead deployed in FY 1986) demonstrated required penetration and destructive performance against this critical target set. Integration of the I-2000 with the GBU-15 and AGM-130 guidance systems in FY 1988 will provide valuable standoff range for attacking hardened targets. Using technologies demonstrated during I-2000 development, an improved fuze will be developed that is capable of withstanding increased impact loads while providing a lanyard-less arming system, increased shelf life, and cockpit selectable arming and impact delay times. The improved fuze will maximize the probability of killing hardened targets. In FY 1990, technology allowing a higher impact velocity, rocket boosted penetrator/smart fuze system will have matured, permitting the Boosted Penetrator to enter FSD. This will provide a penetration capability against extremely hardened targets.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	0	15,400	15,700	N/A	135,200	166,300

EXPLANATION: (U) The FY 1987 reduction reflects Congressional action. The FY 1988 decrease reflects revised program schedule, and the FY 1989 decrease reflects inflation adjustments. The change in the total estimated cost for this program reflects a change in program content. Development of a smaller penetrating warhead (I-1000) is no longer required.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: The Hardened Target Munitions program incorporates technologies from PEs 62602F, 63601F, 64602F, and 64604F in the areas of propulsion, casing, fuzing, and explosives. Of key importance to the Boosted Penetrator will be the timely completion of the Hardened Target Weapon technology currently being developed under PEs 62502F and 63601F.

6. (U) WORK PERFORMED BY: Contractors will be selected in FY 1988. Armament Division at Eglin AFB, FL, is the developing organization responsible for the program.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3273, I-2000 Pre-Planned Product Improvement (P I)

A. (U) Project Description: Objective is to expand the configurations using the I-2000 warhead (BLU-109/B) by integrating the I-2000 with the GBU-15 and the AGM-130 guidance systems. Also, an improved fuze with capability to withstand greater impact loads will be developed.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Not Applicable.

(2) (U) FY 1987 Program: Not Applicable.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: A Full Scale Development contract for GBU-15/AGM-130 integration with the I-2000 will be awarded in FY 1988. Initial development will include trade studies, paper fit test and the fabrication of necessary interface hardware. Software changes will be made if necessary. A quantity of I-2000s and hardened targets will be constructed to support all phases of the testing. GBU-15/AGM-130 cost estimate was based on an Aug 86 cost estimate and on I-2000 program experience.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: During FY 1989, wind tunnel tests and aircraft certification test will be accomplished and DT&E/IOT&E will be started. Engineering drawings and specifications will be prepared. Development of an improved fuze capable of withstanding greater impact loads with cockpit selectability will be initiated.

(5) (U) Program to Completion: In FY 1990, DT&E/IOT&E of the GBU-15/AGM-130 will be finished and Full Scale Development of the Boosted Penetrator will start. The Boosted Penetrator will employ the improved fuze and a rocket boosted warhead(s) to defeat high value, heavily hardened targets.

C. (U) Major Milestones:

Milestones		Dates: Dates
(1) (U) Contract Award	*(January 1987)	June 1988
(2) (U) Critical Design Review	*(July 1987)	December 1988
(3) (U) DT&E/IOT&E	*July 1988- November 1989)	February 1989 - September 1989

(U) Explanation of Milestone Changes:

(U) Changes in schedule were caused by Congressional action which denied funds for FY 1987 and a reallocation of assets to Project Number 3273, I-2000 Pre-Plannad Product Improvement.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64362F
DOD Mission Area: 242 - Theater-Wide Nuclear Warfare

Title: Ground-Launched Cruise Missile
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		1885	0	5299	958	0	389,942

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The purpose of the Ground-Launched Cruise Missile (GLCM) is to counter modernization of Soviet long-range theater nuclear forces, particularly SS-20s and Backfire bombers. The need is for a highly survivable system with enough range to reach targets in the western military districts of the Soviet Union, thus helping to deter a combined Warsaw Pact and Soviet force which has numerical superiority in both conventional and theater nuclear forces. This program element provides for full-scale development to adapt the TOMAHAWK cruise missile into a tactical, mobile ground-launched system.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	667	7377	0	NA	0	391,074
Missile Procurement	516,423	141,438	57,839	NA	0	2,882,900

(U) The FY 1986 RDT&E increase ($1.2M) was a reprogramming to fund GLCM System Program Office (SPO) support due to transition of the GLCM program from the Joint Cruise Missile Project to the Aeronautical Systems Division (ASD).

(U) The RDT&E decrease in FY 1987 ($7.4M) was a Congressional reduction due to funding priority.

(U) The FY 1988 RDT&E increase ($5.3M) was necessary to fund a nuclear safety cross-check analysis and provide systems engineering/technical support services, continue operation of Site Activation Task Forces (SATAFs) and operate the SPO at ASD.

Program Element: 64362F — Title: Ground-Launched Cruise Missile
DOD Mission Area: 242 - Theater-Wide Nuclear Warfare — Budget Activity: 4 - Tactical Programs

(U) The FY 1989 RDT&E increase ($1M) provides funding to deactivate the SATAFs at various Main Operating Bases, complete the remaining residual Program Management Responsibility Transfer tasks, complete final software transition for the Missile Procedures Trainer and fund SPO travel and communications requirements.

4. OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional To Completion	Total Estimated Cost
Missile Procurement (PE 27314F)						
Funds	464,785	123,812	77,306	11,056	8500	2,840,100
Quantities	(95)	(76)	(37)	(0)	(0)	(597)
Military Construction: (Excludes schools, family housing & NATO-funded oper. facilities)	43,515	34,520	41,810	0	0	366,660
Department of Energy Cost	[					]

5. (U) RELATED ACTIVITIES: The Ground-Launched Cruise Missile (GLCM) program adapts the Navy TOMAHAWK missile, PE 64367N, to a tactical, mobile ground-launched system. The Air-Launched Cruise Missile (ALCM), PE 64361F, is a related cruise missile program.

6. (U) WORK PERFORMED BY: The Aeronautical Systems Division located at Wright-Patterson Air Force Base, Ohio has overall responsibility for the GLCM development and production. The January 1977 Cruise Missile Defense Systems Acquisition Review Council II direction established the Joint Cruise Missiles Project Office (JCMPO) with the Navy as lead Service to manage current cruise missile development with special emphasis placed on commonality between programs. Since September of 1985, the Aeronautical Systems Division, Wright-Patterson AFB, OH, has assumed responsibility for the management of the GLCM-unique elements of the program and system integration. In September 1986, the JCMPO was disestablished and NAVAIRSYSCOM (PDA-14) was assigned program management responsibility for TOMAHAWK missiles and the Sea-Launched Cruise Missile Systems. NAVAIRSYSCOM (PDA-14) continues to manage the production of the GLCM TOMAHAWK missile as well as joint aspects of TOMAHAWK logistics.

(U) The Tactical Air Command, Langley AFB, VA, is responsible for operational test and evaluation. The Utah Test and Training Range is the GLCM primary test site. General Dynamics, San Diego, CA and McDonnell Douglas, St. Louis, MO are the contractors for the TOMAHAWK missile airframe and guidance system. Williams International, Walled Lake, MI, is the contractor for the engine with Teledyne, Toledo, OH, as a dual source for the engine. General Dynamics produces the transporter erector launchers (TELs) and the launch control centers (LCCs). GTE Sylvania is the communications subcontractor. Lockheed, Austin, TX, is the weapons control system software and integrating contractor with McDonnell Douglas, St Louis, MO, providing the hardware.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 64362F, Ground-Launched Cruise Missile (GLCM)

A. (U) Project Description: The three primary elements of the GLCM system are the missile, the Transporter Erector Launcher (TEL), and the Launch Control Center (LCC). The missile is a variation of the TOMAHAWK (BGM-109) cruise missile currently being produced by the Navy. The TEL consists of a launcher containing four missiles which, along with associated electronic and power production equipment, is mounted on a semi-trailer. The LCC shelter is also mounted on a semi-trailer. It houses the missile launch crew and the equipment necessary for communications, missile status monitoring and missile launch. The design of the TEL, LCC, weapons control system hardware/software, and associated electronics comprise the bulk of the program. System integration and testing make up the balance of the effort.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: The FY 1986 program continued reliability and maintainability data analysis to identify and implement material improvement projects. Full operational capability (FOC) software development and launch equipment improvements with nuclear certification continued. The FY 1986 program also continued support of main operating base (MOB) site activation task forces and funded program office travel, communications, and system program office (SPO) support.

(2) (U) FY 1987 Program: The FY 1987 planned program would have completed material improvement projects necessary to establish a final system baseline and meet projected system reliability and maintainability goals. It included hardware development to incorporate REGENCY NET equipment into the GLCM missile procedures trainers which are required to maintain nuclear certification of launch officers. The FY 1987 program also would have provided program office travel, communications and SPO support and continued support of main operating base site activation task forces in Europe.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The FY 88 Program funds a nuclear safety cross check analysis and provides system engineering and technical assistance support. It also provides for continued operation of site activation task forces at European MOBs, and continued operation of the system program office. This estimate is a planning estimate and would be categorized as Category IV, Planning.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The program will be completed with the deactivation of Site Activation Task Forces (SATAF) at each MOB. The remaining residual tasks of PMRT will be accomplished. Final software transition for the Missile Procedures Trainer (MPT) will be accomplished in FY 89. The FY 1989 program also provides program office travel, communications, and SPO support. This estimate is a planning estimate and would be categorized as Category IV, Planning.

(5) (U) Program to Completion: The GLCM program will be completed in FY 1989.

C. (U) Major Milestones:

		Milestones		Dates	
(1)	(U)	Defense Systems Acquisition Review Council II		January	1977
(2)	(U)	Program Initiation		October	1977
(3)	(U)	First Full-Scale Engineering Development Flight		May	1980
(4)	(U)	Critical Design Review		March	1981
(5)	(U)	First Test Article Delivered		September	1981
(6)	(U)	Complete Development/Initial Operational Test & Evaluation		July	1983
(7)	(U)	Air Force Systems Acquisition Review Council Program Reviews		May/October	1983
(8)	(U)	Greenham Common UK Initial Operational Capability (IOC)		December	1983
(9)	(U)	COMISO IT IOC		March	1984
(10)	(U)	Follow-On Operational Test and Evaluation Phase I		April	1984
(11)	(U)	Florennes BE IOC		March	1985
(12)	(U)	Wueschheim GE IOC		March	1986
(13)	(U)	Follow-On Operational Test and Evaluation Phase II	*(June 1986)	TBD	TBD
(14)	( )				
(15)	( )				
(16)	(U)	Deployments Completed		December	1988

*Date presented in FY 1987 Descriptive Summary.

(S) Explanation of Milestone Changes:

(13) (U) FOT&E II is being delayed to include a sample of our latest configuration deployed missiles. The exact number to be tested and projected test completion date has not been determined yet.
(15)

8. (U) COOPERATIVE AGREEMENTS:

Italy - This Memorandum of Understanding, signed 9 Nov 83, concerns stationing of missiles, equipment and other supporting hardware at Comiso, Italy. This is comprised of with facilities including the Italian Airfield Command Area, Flying Infrastructure Area, GLCM Alert and Maintenance Area, U.S. Support Infrastructure Area and a Family Support Area. The U.S. Site Commander controls Italian personnel operating within the security squadrons (operational control only). U.S. Forces will retain custody/control of all U.S.weapons under U.S./NATO guidelines and perform maintenance, surveillance and assembly of weapons. All operations specified in the SHAPE Operational Concept are permitted at Comiso. Ground transportation in the Italian countryside will be conducted under Italian control and U.S. custody. Military and contract air transportation for

embarkation/debarkation of personnel, equipment and supplies is authorized without constraint. The U.S. will be compensated by Italy for the residual value of all facilities acquired, developed and constructed at U.S. expense. U.S. Forces contract to Italian Forces for telecommunications and electricity. The U.S. will pay a maximum of 50 million Lire to help restore Building 108 for U.S. office space. A Joint U.S./Italian Security and Defense Force performs peacetime security and training. Primary accounting and financial responsibilities are handled by the 487 TMW/ACF.

Belgium - This Technical Arrangement, signed 29 Feb 84, concerns stationing of missiles, equipment and other supporting hardware at Florennes, Belgium. This is comprised of a Tactical Missile Wing and associated facilities including the Belgian Airfield Command Area, Flying Infrastructure Area, GLCM Alert and Maintenance Area, U.S. Support Area and the Family Support Area. The U.S. Site Commander has control over Belgium personnel operating within the security squadrons (operational control only). U.S. Forces will retain custody/control of all U.S. weapons under U.S./NATO guidelines and perform maintenance, surveillance and assembly of weapons. All operations specified in the SHAPE Operational Concept are authorized at Florennes. Ground transportation in the Belgium countryside will be conducted under Belgium control and U.S. custody. Military and contract air transportation for embarkation/debarkation of personnel, equipment and supplies is authorized without constraint. The U.S. will be compensated by Belgium for the residual value of all facilities acquired, developed and constructed at U.S. expense. Belgium provides free telecommunication support and petroleum, oils and lubricants on contract to the U.S. Forces for GLCM operational support. A Joint U.S./Belgium Security and Defense Force provides peacetime security of nuclear weapons and training IAW Allied Command Europe Directive 80-6 (ED) 60-10.

United Kingdom - This Memorandum of Understanding, signed 17 Sep 85, concerns stationing of missiles, equipment and other supporting hardware at Molesworth, UK and Greenham Common, UK IAW with NATO status of forces agreements dating back to 1951 and reflects the 1979 decision to modernize NATO's long-range theater nuclear defense. The agreement authorizes with facilities including the UK Airfield Command Area, Flying Infrastructure Area, GLCM Alert and Maintenance Area, U.S. Support Infrastructure Area and a Family Support Area. The U.S. Site Commander has control over UK personnel operating within the security squadrons (operational control only). U.S. Forces will retain custody/control of all U.S. weapons under U.S./NATO guidelines and perform maintenance, surveillance and assembly of weapons. All operations specified in the SHAPE Operational Concept are permitted at both Molesworth and Greenham Common, UK. Ground transportation through the UK countryside will be conducted under UK control and U.S. custody. Military and contract air transportation for embarkation/debarkation of personnel, equipment and supplies are authorized without constraint. The UK Ministry of Defence provided 4 million pounds sterling to help compensate for the cost of the GLCM weapons system and provides 220 personnel for joint security/defense duties. Utilities within a boundary which is 20 meters from NATO-funded facilities are 100% NATO-funded except for sewage treatment plants, water pressure booster stations and main transformer voltage stepdown stations. These utilities cost NATO 50% of the charges. U.S. Forces pay for petroleum, oils and lubricants. Normal base communications is funded by USAFE. Long-distance communication costs are shared by USAFE/UK. U.S. Forces operate all crash, fire and rescue equipment and perform all housing facility renovation funded by the UK (deducted from the 4 million pounds at Jun 80 prices).

Program Element: 64362F

DOD Mission Area: 242 - Theater-Wide Nuclear Warfare

Title: Ground-Launched Cruise Missile

Budget Activity: 4 - Tactical Programs

Netherlands - This Memorandum of Understanding, signed 4 Nov 85, concerns stationing of missiles, equipment and other supporting hardware at Woensdrecht, NL. This consists of a Tactical Missle Wing with facilities including the Dutch Airfield Command Area, Flying Infrastructure Area, GLCM Alert and Maintenance Area, U.S. Support Infrastructure Area and a Family Support Area. The U.S. Site Commander controls all Dutch personnel operating within the security squadrons (operational control only). The U.S. Forces retain control/custody of all U.S. weapons under U.S./NATO guidelines and perform all maintenance, surveillance and assembly of weapons. All operations as specified in the SHAPE Operational Concept are permitted at Woensdrecht. Ground transportation through the Dutch countryside is conducted under Dutch control with the U.S. retaining custody. Military and contract air transportation for embarkation and debarkation of personnel, equipment and supplies is authorized without constraint. The Dutch authorize a maximum of 15 full-flight, off-base exercises and dispersal practices within one calendar year. There is no limit to the number of practices within the Base Support Area or GLCM Maintenance and Support Area. The U.S. pays 100% of the cost of sole-use facilities, with the cost of joint-use facilities being charged by pro-rata share. The U.S. is limited to building a maximum of 740 housing units funded by Military Construction Accounts. Telecommunications is funded by the NATO Infrastructure Program.

Budget Activity: 4. Tactical Programs
Program Element: 64362F, Ground-Launched Cruise Missile (GLCM)

Test and Evaluation Data

1. (U) Development Test and Evaluation (DT&E): The Ground Launched Cruise Missile program is managed by the Aeronautical Systems Division of Air Force Systems Command. General Dynamics and McDonnell-Douglas are the missile contractors and General Dynamics is the integrating contractor. The Air Force Flight Test Center was the development test agency. Development testing incorporated test results from the Sea Launched and Air Launched Cruise Missile programs to reduce GLCM test requirements. Applicable areas included engine performance qualification, airframe, navigaton/guidance, and missile performance.

(U) The first of three contractor test launches was a TOMAHAWK missile from an engineering test unit of the Transporter Erector Launcher (TEL) on 16 May 1980 at Dugway Proving Ground, Utah and was a partial success. This test missile was recovered early due to an oil leak. The other two contractor test flights were successful.

(U) The seventh and last Development Test and Evaluation/Initial Operational Test and Evaluation (IOT&E) flight test was completed on 27 July 1983. All DT&E/IOT&E flights were successful except for a guidance problem which curtailed the 27 August 1982 mission and a pneumatic pressure system problem which prevented air inlet deployment and start of the cruise engine on the 17 December 1982 mission.

(U) The DT&E program also provided data in the areas of flight test, environmental test, and operations and maintenance demonstrations. The flight test program provided W84 warhead flight test data to the Department of Energy, investigated launch environment effects on the TEL, and provided data to evaluate system performance for compliance with the system specification. Environmental tests demonstrated the adequacy of the GLCM system to function through its expected range of environments. The operations and maintenance demonstrations focused on maintenance of the GLCM ground systems since the GLCM maintenance concept providea for only limited maintenance on the missile.

(U) The primary test site was the Utah Test and Training Range with tests also conducted at Aberdeen Proving Ground, MD, and Eglin Air Force Base, FL. Tests were conducted using a total of three Launch Control Centers, four Transporter Erector Launchers, nine missiles and related support equipment. Recovery and refurbishment of flight tested missiles enabled multiple test launches of individual missiles.

(U) An Extended Storage Program (ESP) during Development Test and Evaluation/Initial Operational Test and Evaluation used three missiles to help assess Ground Launched Cruise Missile system storage reliability.

Budget Activity: 4. Tactical Programs
Program Element: 64362F, Ground-Launched Cruise Missile (GLCM)

(U) Chemical testing on the Launch Control Center was conducted between August 1983 and October 1983.

(U) Missile qualification to GLCM environment was successfully conducted in November 1983.

(U) Corrections to power generator and fuel system deficiencies identified during DT&E are being implemented into the production line and retrofitted into the fielded system in the latter part of 1987.

(U) The GLCM weapon system completed Electromagnetic Pulse (EMP) testing in 1985.

2. (U) Operational Test and Evaluation (OT&E): The overall objective of OT&E is to provide a valid estimate of the operational effectiveness and suitability of the GLCM weapon system, to identify operational deficiencies and to identify the need for any modifications. The Air Force Operational Test and Evaluation Center (AFOTEC) is the OT&E Command. The Tactical Air Command (TAC), US Air Forces Europe (USAFE), Air Training Command (ATC), Air Force Logistics Command (AFLC), and Military Airlift Command (MAC) are participating commands. Personnel from US European Command (EUCOM) are participating in OT&E of the Mission Planning Subsystem.

(U) The principal flight test location for GLCM OT&E is the Utah Test and Training Range (UTTR), Utah. All test air vehicles will have telemetry packages and remote control systems installed.

(U) Initial Operational Test and Evaluation (IOT&E) of GLCM was conducted by AFOTEC to provide an initial estimate of operational effectiveness and suitability of the weapon system.

(1) OT&E of the GLCM weapon system officially started on 19 May 1982 with the successful launch of the first DT&E/IOT&E flight test. The seventh and final DT&E/IOT&E flight test was launched on 27 July 1983. Overall operational effectiveness of the GLCM weapon system was rated satisfactory.

(2) (U) A Dispersal Evaluation exercise was conducted at McChord AFB/Ft Lewis, Washington, during January 1983. A GLCM flight consisting of two Launch Control Centers and four Transporter Erector Launchers, security forces, and supply/support vehicles moved from Dugway Proving Ground, Utah, to McChord AFB, Washington, in convoy. At Ft Lewis, the dispersed GLCM flight was evaluated under realistic wartime environment and threat conditions.

Specific areas of evaluation included operational concepts and procedures, preflight detectability and survivability, deployment and relocation, maintenance concept, resupply, communications, human factors, and operational timelines. The exercise was successful even though some problems in the areas of power generation, communications security, and human factors were highlighted.

(3) (U) The Initial Operational Test and Evaluation final report was published in February 1984.

Budget Activity: 4. Tactical Programs
Program Element: 64362F, Ground-Launched Cruise Missile (GLCM)

(U) Follow-on Operational Test and Evaluation (FOT&E) Phase I was conducted by Air Force Operational Test and Evaluation Center to complete evaluations not finished during IOT&E, to refine IOT&E estimates, evaluate changes and modifications to correct previously identified deficiencies, and to identify additional deficiencies.

(1) (U) FOT&E Phase I started on 1 June 1983 and was completed on 30 June 1984. Those aspects of Sea Launched Cruise Missile (SLCM) and Air Launched Cruise Missile (ALCM) mission reliability, performance and survivability testing which reflect GLCM operational requirements were used in conjunction with formal GLCM Operational Test and Evaluation test data. On 19 November 1983, the first FOT&E Phase I flight test impacted the ground after 19 minutes of flight. Cause of the failure was determined to be a missile generator failure. The remaining two FOT&E Phase I flights were successfully completed in April 1984.

(2) (U) The FOT&E Phase I final report was published in August 1984. The report stated that the weapon system can perform its mission. However, management attention is required in the areas of power generation, system software, technical orders, trainers and human factors. These areas are and will continue to receive management attention. Communications were evaluated in a benign environment due to test limitations and were not rated; however, HF radio reception was poor even in the benign environment. The Regency communications update within the Theater is scheduled which will improve communication in a jamming environment.

(U) FOT&E Phase II analysis began in July 1984 and will end in 1987. The exact completion date has not been determined since FOT&E II is being delayed to include a sample of our latest configuration deployed missiles. The purpose of FOT&E Phase II is to ensure that the system can meet changing operational requirements; support Department of Energy (DOE) warhead testing; comply with requirements of Weapon System Evaluation Group 92 (WSEG-92) directives; identify operational deficiencies and confirm that previously identified deficiencies have been corrected; and provide for a continuing analysis of operational effectiveness and suitability. The United States Air Force Tactical Air Warfare Center (USAFTAWC) will conduct the Tactical Air Command (TAC) operational test program. The test team is based at Davis-Monthan AFB, AZ, with operating locations at Hill AFB, UT, and Dugway Proving Ground, UT. United States Air Forces Europe (USAFE) and USAFTAWC have established theater ground system and Command Control Communications data collection programs and have forwarded data to USAFTAWC, Detachment 2 for assessment.

(U) Phase II will consist of flight tests conducted in the Continental United States (CONUS) and ground tests conducted in both the CONUS and at operational bases. Nineteen flight tests are scheduled. The missiles will be refurbished and returned to the operational inventory. The first FOT&E Phase II flight test failed 22 seconds after launch on 18 September 1984. The missile did not transition to cruise flight because the engine inlet scoop failed to deploy. A defective actuator was found and redesigned. Since the first test 13 additional GLCM flights have been completed. In addition to flight tests, ground tests will be used to evaluate equipment modifications and to develop and/or improve operational procedures.

(U) GLCM Weapon System Evaluation Program (WSEP), a life cycle test-program, will be conducted by USAFTAWC and USAFE after the completion of the GLCM FOT&E Phase II. USAFTAWC and USAFE will comply with applicable Air Force

Budget Activity: 4. Tactical Programs
Program Element: 64362F, Ground-Launched Cruise Missile (GLCM)

directives and the Joint Chiefs of Staff (JCS) reporting requirements by establishing an evaluation program designed to determine changes in reliability and accuracy that may occur with the passage of time. The WSEP, consisting of twelve test flights per year, will begin after completion of FOT&E II and will continue through the life of the weapon system.

(U) As in FOT&E Phase II, missiles will be selected from the field and/or production line in a way that will provide an age/model mix that represents the deployed force. Additionally, combat ready launch crews, maintenance and security police personnel from the deployed Main Operating Bases (MOBs) will be required to conduct the test launches.

3. System Characteristics:

Physical Characteristics

TOMAHAWK (BGM-109G)	
Length (without booster)	219 inches
Weight	2700 lbs
Warhead (W84)	
Number of missiles per TEL	4
Approximate TEL weight including tractor	78,000 lbs
Number of TELs controlled by LCC	4
Approximate LCC weight	79,000 lbs

Missile Performance	Goal	Mature Threshold*	Estimate at FOC (Dec 88)
Speed (Mach)			
Max Penetration			
Cruise			
Range (Kilometers)	2500	2500	2500
Penetration Altitude, Smooth Terrain (Feet, above ground level)			
Circular Error Probability (CEP)(Feet)			
Operational Availability	.95	.81	.96
System Reliability			
Mission Reliability			

* - Mature threshold is applicable at Full Operational Capability (Dec 88).
** - Current estimate is based on test data or analysis.

*** - The high end of each range is based on actual test data (40 flight tests with an average mission length of 1.4 hours) as adjusted for actual or projected configuration improvements. The low end of each range is a conservative

extrapolation based on seven data points to account for a three hour mission length. The range is given because of the uncertainty associated with extrapolating reliability projections based on a small sample (seven failures).

[a] - Threshold achieved or exceeded as of June 1984.
[b] - CEP is estimated using test targets 26 NM from the last TERCOM update.

4. (U) Current Test and Evaluation (T&E):

T&E Activity (Past 12 Months)

Event	Planned Activity	Actual Date	Remarks
FOT&E Phase II Flight Test #11	May 1986	26 June 1986	Successful
FOT&E Phase II Flight Test #12	May 1986	26 June 1986	Successful
FOT&E Phase II Flight Test #13	May 1986	30 June 1986	Failure-crashed during rocket boost phase
FOT&E Phase II Flight Test #14	June 1986	16 September 1986	Failure-crashed during rocket boost phase

T&E Activity (Next 12 Months)

Event	Planned Activity	Remarks
FOT&E Flights 15-19	March 1987 - TBD	*
GLCM Weapon System Evaluation Program (WSEP) Flight Tests #1 - 6	TBD	*

*FOT&E flights 15 - 19 and WSEP flights 1 - 6 have been put on hold pending preparation of latest deployed configuration missiles for flight test.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64601F
DOD Mission Area: 276 - Defensive Chemical and Biological Systems

Title: Chemical/Biological Defense Equipment
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	10,102	22,198	14,600	17,678	Continuing	N/A
3321	Chemical and Biological Agent Detection & Warning	1,900	2,100	3,400	5,600	Continuing	N/A
3337	Individual Protection	2,670	10,898	7,877	5,578	Continuing	N/A
3762	Collective Protection	4,359	6,500	2,200	3,000	Continuing	N/A
3764	Decontamination	273	1,700	1,123	3,500	Continuing	N/A
5171	Bigeye	900	1,000	0	0	0	8,140

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program develops systems to detect, warn against, protect, and decontaminate personnel and equipment from chemical/biological agents. These systems will allow the Air Force to continue its mission in a chemical/biological environment and provide a critical deterrent to Soviet use of chemical/biological weapons. Without these protective systems sortie generation on a sustained basis will be degraded significantly. This program also funded the Air Force munitions development of the Bigeye binary chemical bomb.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	21,915	27,187	27,623	N/A	Continuing	N/A
Other Procurement	81,233	120,958	166,956	N/A	Continuing	N/A

EXPLANATION: (U) Reduction in FY 1986 was due to a delay in award of the Aircrew Eye-Respiratory Protection development contract. FY 1987 was reduced by Congressional appropriation action. Reductions in 1988 were for several reasons. A Filter Life Indicator project was deleted based on a determination that chemical protection filters have a toxic agent absorption capability great enough to allow economical replacement on a periodic basis. Also, third generation chemical/biological defense equipment development funds were reduced due to the Army's acceptance of additional tasks under the Joint Services Agreement for Coordination of Chemical Warfare and Chemical-Biological Defense Requirements.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Other Procurement Funds	65,742	81,494	108,960	198,539	Continuing	N/A
Operation and Maintenance Funds	28,623	29,739	27,738	31,428	Continuing	N/A

5. (U) RELATED ACTIVITIES: The related Air Force programs are: PE 27593F, Chemical Biological Defense Program, PE 62202F, Aerospace Biotechnology; PE 63745F, Chemical Warfare Defense; PE 64617F, Air Base Survivability; and PE 64703F, Aeromedical Chemical Defense Systems Development. Tasks are coordinated with other services in accordance with the Joint Service Agreement on Chemical Warfare and Chemical-Biological Defense Requirements, Research, Development, and Acquisition of 5 July 1985. The related Army programs are: PE 62706A, Chemical/Biological Defense and General Investigation; PE 63721A, Chemical/Biological Protective Material Concepts; PE 64724A, Chemical/Biological Detection Warning and Training Material; and PE 64275A, Chemical/Biological Protective Material. The related Navy programs are: PE 62233N, Mission Support Technology; PE 64506N, Chemical/Biological/Radiological Warfare Countermeasures. The related Marine Corps program is PE 63635M, Marine Corps Ground Combat/Support Arms.

6. (U) WORK PERFORMED BY: The top five contractors are: (1) Honeywell, Clearwater, FL (Project 3321), Chemical and Biological Agent Detection and Warning); (2) Geomet, Rockville, MD (Project 3337, Individual Protection); (3) Rohm and Haas, Philadelphia, PA (Project 3337, Individual Protection); (4) Systems Research Laboratory, Beaver Creek, OH (Project 3762, Collective Protection); (5) Gentex, Carbondale, PA (Project 3337, Individual Protection). There are seven additional contractors, and the total value of the additional contracts is $3.1 million. The in-house developing organization for projects 3321, 3337, 3762, and 3764 is Air Force Systems Command's Aeronautical Systems Division, Life Support Systems Program Office, Wright-Patterson AFB, OH.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 3762, Collective Protection. The purpose of this project is to develop collective protection systems for use in a chemical warfare environment to provide for rest and relief of groups of personnel and allow performance of selected tasks which cannot be performed by personnel encumbered by individual protective equipment. The first Survivable Collective Protection System (SCPS) initial production units were fielded in FY 1986. SCPS pre-planned product improvements continued on schedule. Development continued on a family of Transportable Collective Protection Shelters. Development Test and Evaluation and Initial Operational Test and Evaluation will be conducted on

Transportable Collective Protection Shelters in FY 1987 to be followed by a production decision. This testing will evaluate the addition of a contamination control area to existing modular collective protection equipment, simplified collective protection equipment, and several current inventory mobile shelters. In FY 1988 a production decision will be made for an improved version of the Army's M-20 Simplified Collective Protection Equipment. In addition, development will begin on chemical hardening of other selected shelters and facilities. These tasks will continue in FY 1989 and beyond.

B. (U) Project: 3764, Decontamination. This project develops materials, methods, and equipment for removing/neutralizing chemical warfare agents from personnel, vehicles, aircraft, equipment and facilities without imposing adverse effects on equipment and mission performance. Decontamination is required so personnel can work safely and unencumbered after a chemical/biological attack. FY 1986 efforts monitored Army progress and analyzed Army hardware items in the field to determine if they satisfy Air Force requirements. Requirements for urgent European theater avionics decontamination equipment were provided to the Army for incorporation into a freon based decontamination development program. The FY 1987 program will provide for installation engineering of a large version of an avionics decontamination candidate system and development of a smaller system. The FY 1989 program will initiate development of an aircraft interior decontamination system and continue development of an avionics decontamination system. A production decision for the avionics decontamination system will be made in late FY 1989. Tasks beyond FY 1989 will focus on techniques and equipment for decontamination of air base critical equipment and components.

C. (U) Project: 3321, Chemical and Biological Agent Detection and Warning. This project develops a capability to detect and warn against chemical and biological agents automatically and indicate the degree and location of contamination so that corrective action can be taken to allow unimpeded continuation of the mission. The FY 1986 program completed IOT&E of the Surface Contamination Monitor (SCM). Results indicated that the technology used in the SCM is not sufficiently mature for full scale development. The Air Force will continue to monitor the Army's development of ion mobility spectroscopy technology under the Advanced Chemical Agent Detector and Alarm (currently a 6.3 program) which appears more promising and is approaching the originally scheduled SCM production date. The Automatic Liquid Agent Detector went into initial production under a joint effort with the Army. The FY 1987 program will start full-scale development of a Fixed Site Chemical Detection and Warning System (FSDWS). The FY 1988 program will continue efforts initiated in FY 1987. The FY 1989 program will continue development of the FSDWS and initiate development of a Personnel and Equipment Contamination Sensor (PECOS) system. It will also initiate full-scale development of a remote chemical agent cloud sensing device. Tasks beyond FY 1989 will complete development of the FSDWS, PECOS, and a remote chemical agent cloud sensing device and initiate development of microdetectors.

D. (U) Project: 3337, Individual Protection. This project develops protective ensembles and equipment systems. These systems will protect personnel from effects of chemical or biological agents and allow them to maintain mission performance effectiveness. Work under this project includes development of the Aircrew Eye-Respiratory Protection

system, aircrew chemical protective ensemble, an Impermeable Protective (IMP) Suit for Air Force special teams, and body cooling systems. The IMP suit will be used by Explosive Ordnance Disposal personnel and is based on technology demonstrated during an airbase survivability exercise in Europe during the spring of 1985. The Aircrew Eye-Respiratory Protection System (AERP) is the improved aircrew mask program. The AERP program approach is to adapt components of successful mask developments to applicable aircraft and begin fielding mask systems by FY 1988. Masks being considered under the AERP program include the AR-5 (British), XM-43 (Army), In-Helmet (Dutch), Tactical Aircrew Eye Respiratory System (ILC Dover Corp.), and Advanced Chemical Defense Aircrew Respirator (in-house Air Force). The FY 1986 program continued development of the AERP system, the aircrew chemical defense ensemble and the IMP Suit system. Initial evaluation test flights of several candidate AERP systems were completed. In addition, several candidate aircrew chemical defense ensembles (flightsuits) were evaluated to replace the heavy three layer fabric system. Full scale development of the impermeable suit continued. The FY 1987 program will initiate Development Test and Evaluation/Initial Operational Test and Evaluation (DT&E/IOT&E) of an AERP system for the F-16, C-130, and the KC-135, and initiate development of the aircraft integration hardware for these aircraft. In addition, development of the new aircrew chemical defense ensemble and the IMP suit will be continued. The FY 1988 program will continue DT&E/IOT&E of AERP systems in other aircraft types as well as limited production and fielding of AERP systems. IOT&E will be completed for the IMP suit and a production decision will be made. A production decision will also be made on the aircrew chemical defense ensemble. The FY 1989 program will continue IOT&E of AERP for additional aircraft types. Tasks beyond FY 1989 will include development of equipment to provide for verbal communications by ground crew wearing protective masks on the flight line and in other high noise areas; and a positive pressure ground crew mask for improved protection of specialized duty personnel.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64602F
DOD Mission Area: 223 - Close Air Support and Interdiction

Title: Armament/Ordnance Development
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	16,836	20,000	25,629	19,176	Continuing	N/A
2586	Dispenser Munitions	2,494	9,783	17,141	11,015	Continuing	N/A
2784	Armament Standardization/ Control	870	1,907	2,648	2,164	Continuing	N/A
3113	HAVE VOID/I-2000 Warhead	6,875	1,151	2,942	0	0	27,835
3133	Bombs and fuzes	2,749	2,454	2,157	2,556	Continuing	N/A
3590	Munitions Storage Enhancements	0	0	741	2,458	Continuing	N/A
3627	Cast Bomb Development	0	4,000	0	983	0	4,983
5613	Carriage, Release and Handling Equipment/ Containers	3,848	705	0	0	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This PE is the primary source for modernizing and developing unguided air-to-surface conventional munitions and associated equipment. The program supports numerous Strategic Air Command and Tactical Air Forces Statements of Need. There are two categories of efforts: those to provide new capabilities to fill operational voids, and those to eliminate deficiencies in current capabilities by modernizing existing munitions and equipment. Efforts also include formal organizations to help standardize munitions and associated equipment. Activities involve the engineering design, development, test and evaluation of a variety of improved conventional weapons and munitions handling equipment. This PE includes: bombs and hardened target warheads; unguided dispenser munitions; bomb fuzes and proximity sensors; munitions handling equipment and containers; mechanical diverters to prevent sympathetic detonation in storage areas and weapons carriage and release equipment.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	17,116	29,773	25,235	N/A	Continuing	N/A
Aircraft Procurement (PE 28031F)	3,798*	0*	3,062*	N/A	3,187*	10,047*
Missile Procurement (PE 11122F)	4,068*	3,967*	0	N/A	0	8,674*
Other Procurement** (PE 28030F)	58,126	79,512	104,124	N/A	Continuing	N/A
(PE 27599F)(PE 28031F)	0	0	0	N/A	Continuing	N/A

* Correction to FY 1987 Descriptive Summary
** Combined Effects Munition funding not included -- not included in FY 1988 Descriptive Summary

Program Element: 64602F Title: Armament/Ordnance Development
DOD Mission Area: 223 - Close Air Support and Interdiction Budget Activity: 4 - Tactical Programs

EXPLANATION: (U) The RDT&E FY 1987 funding was reduced by Congress (-$9.8 million) resulting in a reallocation between projects in FY 1987 and FY 1988. Significant changes in the Other Procurement Appropriation due to FY 1987 Congressional action follow: Project 3113 (I-2000, -$20.5 million), Project 3133 (FMU-139 fuze, -$5.2 million; Timer, Actuator, Fin and Fuze, -$3.0 million). The FY 1988 change (-$12.2 million) is a result of several changes. Direct Airfield Attack Combined Munition was reduced $13.1 million to move first year of production to FY 1990, I-2000 was reduced $5.1 million due to overall funding constraints and the FMU-139 fuze was reduced $4.0 million due to funding constraints. FY 1988 funding (+$10.0 million) was added in PE 28031F for mechanical blast diverters (Project 3590).

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Aircraft Procurement:						
Project #5613, Manually Operated Lift Truck						
Funds (PE 28031F)	3,800	0	2,814	0	3,279	9,893
Quantities	428	0	309	0	343	
Missile Procurement:						
Project #5613, One Step Loading Adapter						
Funds (PE 11122F)	3,082	3,961	0	0	0	7,682
Quantities	616	786	0	0	0	
Other Procurement:						
Project #3113, HAVE VOID/I-2000*						
Funds (PE 28030F)	14,436	37,310**	32,567	31,877	Continuing	N/A
Quantities	1,034	2,440	2,340	2,360		
Project #3133, FMU-139 Fuze***						
Funds (PE 28030F)	39,680	31,629	39,967	41,127	Continuing	N/A
Quantities (FMU-139/B)	45,626	39,069	42,566	47,852		
(DSU-33/B)	0	0	5,000	5,000		

* FY 1986 is HAVE VOID funding in the 2000 lb bomb line; FY 1987 and subsequent is I-2000 Warhead.
** Includes $20.0 million which is in the FY 1987 Supplemental Request.
*** This line includes both the FMU-139/B fuze and the DSU-33/B proximity sensor.

Program Element: 64602F Title: Armament/Ordnance Development
DOD Mission Area: 223 - Close Air Support and Interdiction Budget Activity: 4 - Tactical Programs

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Project #3133, Timer, Actuator, Fin and Fuze						
Funds (PE 28030F)	0	1,916	3,988	3,334	Continuing	N/A
Quantities	0	1,500	14,000	13,067		
Project #3590, Mechanical Diverter						
Funds (PE 28031F)	0	0	9,807	14,783	25,735	50,325
Quantities	0	0	2,800	11,250	17,200	

5. (U) RELATED ACTIVITIES: Submunitions such as the BLU-106/B, Bomb, Kinetic Energy Penetrator, developed in PE 64604F, Submunitions Development, are selected for integration into unguided dispensers under this PE. Items from the advanced development program, PE 63601F, Conventional Weapons, such as the Standard Avionics Integrated Fuze and the HAVE BLOCK mechanical diverter program are selected for continuation into Full Scale Development under this PE. FMU-139 fuze, under Project 3133, is a joint US Navy and US Air Force program. Close liaison is maintained between the services through the Joint Technical Coordinating Group for Munitions Development and through coordination with the Department of Defense Armaments/Munitions Requirements and Development Committee.

6. (U) WORK PERFORMED BY: This PE is managed by the Armament Division at Eglin AFB, FL. The major contractors are Lockheed Missiles and Space Company, Sunnyvale, CA, (Project 3113); Motorola Corporation, Scottsdale, AZ, (Projects 2586 and 3133); Pacific Car and Foundry, Seattle, WA, (Project 5613); AAI, Baltimore, MD (Project 3133). There are six additional contractors with contracts totalling $2.0 million.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 2784, Armament Standardization/Control. This project supports continuing activities which increase standardization and commonality in armament subsystems. The goal is to reduce proliferation and take maximum advantage of prior investments. The Container Design Retrieval System (CDRS) and Munitions Material Handling Equipment (MMHE) data retrieval systems are maintained to ensure maximum use of existing containers, munitions handling equipment and other related items. The CDRS produced documented savings of $37.5 million from October 1979 to April 1986. In FY 1986 an Office for Armament Control was established. This office is the focal point for sponsoring or coordinating activities to enhance munition handling equipment and armament/aircraft interface standardization. In FY 1987 planning begins for the joint Armament/Avionics Planning Conference which will be held in FY 1988. In FY 1987 efforts begin to define and establish a comprehensive aircraft/munitions data base which will provide ready access to aircraft to armament system interface technical data. Development of standard modular software programs applicable to more than one munition begins and will apply the Ada programming language. In FY 1988 and 1989 the CDRS and MMHE data bases are maintained to continue support to on-going munitions programs. The aircraft/munitions technical interface data base effort will be in the data identification/collection phase. In FY 1988 investigations into feasibility of

fuze and armament test set standardization will begin, the objective being to avoid proliferation of similiar material and to reduce development cost and time. This standardization effort continues in FY 1989.

B. (U) Project: 3113, HAVE VOID/I-2000 Warhead. This project develops warheads/weapons which penetrate hardened targets. HAVE VOID was a Quick Reaction Capability program to provide a near-term capability by developing and interfacing an improved 2000 pound penetrating warhead (I-2000) with the GBU-10 guidance kit and demonstrating this compatibility from an F-4E aircraft. The Improved 2000 Pound (I-2000) Warhead program is a pre-planned product improvement program (P^3I) to expand that capability by interfacing with the GBU-24, improving the fuze, and demonstrating compatibility with additional tactical aircraft. In 1986 the HAVE VOID production decision was made to buy the final 1000 weapons. Production delivery of loaded warheads will begin in February 1987 and will be completed in April 1987. The I-2000 P^3I continued. Efforts included developing an improved fuze (the FMU-143A/B) with multiple delay times, interfacing I-2000 to the GBU-24 and improving the transportation and storage pallet. The improved partial build-up/storage pallet was tested and a positive production decision made. Analysis was done to determine desirability of developing an unguided variant of I-2000 to complement the MK-84 inventory as a general purpose bomb. In FY 1987 flight testing of the GBU-24/I-2000 bomb and development of the FMU-143A/B fuze will be completed. I-2000 procurement begins and flight testing of the I-2000 in the unguided configuration will be conducted at a minimal level. Most of the planned FY 1987 work identified in the FY 1987 Descriptive Summary was deferred to FY 1988 in order to develop the Congressionally mandated I-2000 cast bomb (Project 3627). In FY 1988 unguided testing of the I-2000 and other aircraft certification flight testing will be completed.

C. (U) Project: 3133, Bombs and Fuzes. This project develops and improves bombs and fuzes. In FY 1986 Initial Operational Test and Evaluation (IOT&E) of the FMU-139 electronic bomb fuze was completed and a positive production decision was made. A feasibility demonstration of the high drag sensor for the FMU-130/B Dual Mode (high-low drag) was completed and a decision made not to continue with a full scale development (FSD) effort. Development of the DSU-33 proximity sensor continued in FY 1986. The proximity sensor is compatible with the FMU-139 fuze and will allow bombs to be detonated above ground for increased effectiveness against various targets. Development Test and Engineering of the Timer, Actuator, Fin and Fuze (TAFF) was successfully completed. The TAFF is a timing device which delays the fin/retarder actuator on high-drag general purpose bombs until the munition is clear of the bomb bay of B-1B aircraft. In FY 1987 TAFF IOT&E will be completed and initial production is planned to begin. Testing of the DSU-33 and the Navy DSU-30 proximity sensor will be conducted and will be followed by a DSU-30/33 down-selection decision. Procurement of the DSU-33 will begin if it is selected for AF use. If the DSU-30 is selected then additional IOT&E testing will be required before a production decision is made. Studies to prepare for FSD of the Standard Avionics Integrated Fuze (SAIF) will begin. The SAIF is a fuze for air-to-surface weapons which will allow the fuze to be set from the aircraft avionics data bus, thereby matching the fuze setting with the actual delivery conditions for maximum effectiveness. These studies will consider feasibility of designing the SAIF so it can be installed in the bomb raising it to All-Up-Round status without altering the hazard classification of the weapon and also to determine if it can be a hardened target fuze. In FY 1988 FSD for the SAIF will begin. In FY 1989 FSD of the SAIF continues.

D. (U) Project: 3590, Munitions Storage Enhancements. This project develops mechanical and chemical systems which will increase munitions storage capacity in igloos, storage areas, ships, etc., by reducing the hazard classification/safety restrictions associated with munitions. In FY 1987, HAVE BLOCK, a mechanical barrier to deter sympathetic detonation, is planned to transition from PE 63601F (Conventional Weapons Technology) and begin full scale development (FSD). HAVE BLOCK will alleviate immediate on-base storage problems of existing munitions because the mechanical diverter will deter sympathetic detonation (one bomb igniting the other). Because of FY 1987 funding reductions in this Program Element this FSD will be delayed to FY 1988 unless additional funds are provided. In FY 1988, planning for FSD of the Desensitized High Explosive (DHE) will begin. DHE is an explosive compound that is less sensitive to sympathetic detonation and is seen as the mid term solution to reducing safety restrictions on storage of munitions. HAVE BLOCK provides a near-term solution for inventory MK-82 and MK-84 bombs while DHE will be a replacement explosive fill for new MK-82s and MK-84s as they enter the inventory. Both projects are complimentary. In FY 1987 and 1988 HAVE BLOCK FSD efforts will be concentrated on diverters for the Mk 82 bomb. In FY 1988 Mk 84 bomb diverter development will begin.

E. (U) Project: 3627, Cast Bomb Development. This new project is a Congressionally directed effort to fully qualify a cast version of the I-2000 bomb body using $4.0 million of the appropriated FY 1987 funds. The results of this work are to be reported to the Committees on Appropriations when completed. Efforts will begin in late FY 1987 and will be completed in FY 1989.

F. (U) Project: 5613, Carriage, Release and Handling Equipment/Containers. This project develops more capable bomb racks, ejectors and associated handling/release equipment, and improves munitions material handling equipment and containers. In FY 1986 the One-Step Loading Adapter transitioned into production. Development of a Simplified Munitions Lift Trailer (SMLT) for strategic bombers which began in late FY 1985 continued. In FY 1987 Initial Operational Test and Evaluation of a Manually Operated Lift Truck to augment the powered loader force will be completed and a production decision made. In FY 1987 Development Test and Evaluation and Initial Operational Test and Evaluation of the SMLT will be conducted and a production decision will be made. In FY 1989 preparations for FSD for an All-Terrain-Ammunition-Trailer (ATAT) will be initiated. The ATAT will be capable of dispersing munitions in bare base environments where minimal roads exist and/or where roads have been damaged by enemy attack. In FY 1990 the ATAT FSD will begin and efforts will begin to apply the emerging technology of robotics and muscle multipilers to the task of handling and loading munitions.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2586, Dispenser Munitions

A. (U) Project Description: This project develops cost-effective dispenser munitions and improves existing dispenser systems. The Direct Airfield Attack Combined Munition (DAACM) is the only currently active task in this project. The HAVE MAIL program to improve the Tactical Munitions Dispenser was ended in FY 1986. The DAACM program

will weaponize eight BLU-106/Bs (Bomb, Kinetic Energy Penetrator (BKEP)), and 24 British HB-876 area denial mines into a tactical munitons dispenser (TMD). The Direct Airfield Attack Combined Munition (DAACM) will significantly improve our airfield attack capability with multiple cratering of runway and taxiway surfaces. The mines are dispensed with BKEPs to impede repair operations.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Alternative HAVE MAIL prototype configurations were considered and a single design was selected. However, based on emerging technology in materials for TMDs the HAVE MAIL effort was terminated. The HB-876 mine was modified to make it compatible with the ejection method of the DAACM.

(2) (U) FY 1987 Program: Critical Design Review (CDR) and final qualification testing of the preferred fuze for the BKEP will be conducted. Source selection and contract award for DAACM full scale development (FSD) will be conducted. A dual contractor FSD effort is planned to reduce technical/schedule risk and to provide benefits of a competitive development effort. Following contract award the contractors will begin the DAACM design effort.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The contractors will conduct Preliminary Design Reviews (PDR). Based on approval of the PDR the contractors will fabricate DAACM units for prototype testing. Upon completion of prototype testing each contractor will present a baseline design to the government for approval at CDR.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: CDR will be conducted. Fabrication and assembly of DAACMs for Development Test and Evaluation/Initial Operational Test and Evaluation (DT&E/IOT&E) will occur. Upon sucessful completion of DT&E flight testing a single contractor will be selected to continue the FSD program.

(5) (U) Program to Completion: In FY 1990 DAACM FSD ends following completion of IOT&E flight tests. Following successful completion of FSD a production decision for low rate initial production will be made.

C. (U) Major Milestones:

	Milestones		Dates
(1) (U)	Direct Airfield Attack Combined Munition (DAACM) Contract Award	*August 1986	4th Quarter FY 1987
(2) (U)	DAACM Preliminary Design Review		January 1988
(3) (U)	DAACM Critical Design Review		November 1988
(4) (U)	DAACM Development Test and Evaluation/ Initial Operational Test and Evaluation Complete		4th Quarter FY 1990
(5) (U)	DAACM Low Rate Production Decision		FY 1990

*Date presented in FY 1987 Descriptive Summary.

(U) Explanation of Milestone Changes

(1) (U) DAACM full scale development contract award delayed due to Bomb, Kinetic Energy Penetrator fuze modification and test.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64604F Title: Submunitions
DOD Mission Area: 223 - Close Air Support and Interdiction Budget Activity: 4 Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	31,401	4,757	4,668	7,333	Continuing	N/A
3051	Boosted Kinetic Energy Penetrator (BKEP)	5,607	0	0	0	0	28,209
3086	Skeet Submunition	13,333	0	0	0	0	42,804
3166	Terminally Guided Submissile (TGSM)/Sense and Destroy Armor (SADARM)/Skeet Evaluation and Sub-munition Development	12,461	4,757	4,668	7,333	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element develops a family of conventional submunitions to satisfy a variety of operational requirements. The Tactical Air Forces (TAF) require a munition to reduce enemy sortie generation capabilities. The BKEP submunition was developed to provide this capability by cratering runway and taxiway surfaces. Project 3051 developed the dispenser, the ejection subsystem, and integration of Boosted Kinetic Energy Penetrator (BKEP) submunitions into the Tactical Munitions Dispenser (TMD) for runway attack. Due to the large numerical imbalance of Warsaw Pact armored forces, the TAF require a munition that will provide multiple kills per pass in day, night, and adverse weather. In Project 3086 the Skeet submunition was developed to provide this capability. Project 3089 commonly known as "Chicken Little" has been merged with Project 3166, Terminally Guided Sub-Missile (TGSM)/Sense and Destroy Armor (SADARM)/Skeet Evaluation and Submunition Development, to continue Chicken Little activities. Project 3166 evaluates TGSM, SADARM, and Skeet submunition performance and has been expanded to determine antiarmor submunition performance against actual foreign targets. This project provides the basis for institutionalizing the Chicken Little approach for evaluating antiarmor submunitions. Armor targets required to conduct development tests, to evaluate operational munitions, and to provide the independent target set for the Chicken Little approach will be acquired within Project 3166. Project 3166 is a joint project with the US Army and US Navy.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	37,919	4,921	4,767	N/A	Continuing	N/A

EXPLANATION: (U) FY 1986 difference due to Gramm-Rudman-Hollings reduction, inflation, undistributed reductions and higher Air Force priorities. FY 1987 and FY 1988 differences are due to undistributed reductions for profit policy and inflation .

4. (U) OTHER APPROPRIATION FUNDS:

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Submunitions Evaluation/Development Procurement (Other)	0	0	0	0	TBD	TBD

5. (U) RELATED ACTIVITIES: The integration of the Skeet submunition into the tactical munitions dispenser (TMD) to develop the Sensor Fuzed Weapon (SFW) is funded under PE 64607F, Wide Area Antiarmor Munitions. Test efforts for integration of the Boosted Kinetic Energy Penetrator (BKEP) into the TMD to develop the Direct Air Field Attack Cluster Munition (DAACM) for direct over flight attack are in PE 64602F. Prior to creation of this program element, funding for BKEP was under PE 64614F, Medium Range Air-to-Surface Missile. Prior to FY 1985, evaluation of the Terminally Guided Submissile (TGSM) was included in the US Army PE 63303A, Surface-to-Surface Missile Rocket System. Sense and Destroy Armor Munition (SADARM) development effort is conducted under Army PE 63628A, Field Artillery Ammunition Development, and PE 64631A, Field Artillery Ammunition.

6. (U) WORK PERFORMED BY: Program management is provided by Headquarters Air Force Systems Command, Andrews Air Force Base, MD, and subordinate organization, Armament Division, Eglin Air Force Base, FL. Contractor support for BKEP and Skeet submunitions is provided by AVCO Corporation, Wilmington, MA. Contractor support for the TGSM is provided by General Dynamics Corporation, Pomona, CA. Contractor support for the SADARM program is provided by Aerojet Corporation, Downey, CA; Honeywell Inc, Hopkins, MN; and AVCO Corporation, Wilmington, MA.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR 1989:

(U) Project: 3166, Terminally Guided Submissile (TGSM)/Sense and Destroy Armor (SADARM)/ Skeet Evaluation and Submunition Development

A. (U) Project Description: TGSM and SADARM are US Army development efforts. TGSM was a submunition candidate for the Assault Breaker program. SADARM is an artillery-fired weapon with smart sensors to improve the probability of a hit. The sensor fuzed and shaped charge warhead (Skeet) is a US Air Force development effort which will be employed in the SFW. These submunitions will be evaluated for potential application by the Air Force for delivery from standoff weapons. This evaluation includes submunition testing and has been expanded to include the evaluation of effectiveness against sctual foreign targets. The project consists of studies, analysis, and warhead/sensor testing. SADARM, TGSM,

and Skeet testing will continue against newer targets and potential counter measures. A dedicated target set will be procured to enable expanded testing of candidate submunitions for US or allied applications.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: In FY 1986 contracts were awarded for analysis and testing of the Terminally Guided Submissile (TGSM), Sense and Destroy Armor (SADARM), and Skeet submunitions. Airborne sensor tests of foreign tank and non-tank targets and ground warhead testing were conducted. Warhead and sensor data was obtained for future analysis. The data base on target characteristics was expanded and updated.

(2) (U) FY 1987 Program: In FY 1987 the warhead effectiveness testing against additional countermeasures targets will continue. Weapons level cost effectiveness analysis will be completed in order to accomplish a submunition to submunition evaluation of a "generic" 1000 pound class weapon.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Submunition warhead evaluation and flight test will continue in FY 1988. Improved submunitions will be tested against newer targets. Acquisition of armor targets as they become available is planned.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Chicken Little testing will continue against newer targets with potential countermeasures. Dedicated targets will be acquired. Updating of target characteristics for submunition effectiveness modelling will be accomplished.

(5) (U) Program to Completion: Institutionalization of submunition testing to provide an "honest broker" test capability for evaluation of submunitions for future integration into weapons such as the Modular Stand-off Weapon. Continued acquisition of armored targets to form an up-to-date target complex.

C. (U) Major Milestones: Not Applicable.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable

9. (U) COOPERATIVE AGREEMENTS: The Government of Israel (GOI) has participated since FY 1985 in the initial phase of the Chicken Little Project under a Memorandum of Understanding (MOU) with the Government of the United States. The GOI has provided equipment for use in Chicken Little and personnel on site at Eglin AFB, FL, to support testing and data analysis. Funds have not been exchanged between governments. An MOU with the GOI is in coordination for conduct of the second phase of the Chicken Little Project. The scope of the project and GOI participation will be essentially the same for phase II as they were for phase I except the scope of countermeasures testing and resulting analysis will be expanded. Phase II will be two to three years in duration.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64607F
DOD Mission Area: 223 - Close Air Support and Interdiction

Title: Wide Area Anti-Armor Munitions
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	11,320	23,872	17,607	13,278	0	135,663
2961	Sensor Fuzed Weapon	11,320	23,872	17,607	13,278	0	135,663

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Tactical Air Forces require a capability to destroy multiple enemy tanks during a single aircraft pass to overcome the existing large numerical imbalance of Warsaw Pact armor. This need is documented in the Mission Element Need Statement for an Improved Wide Area Antiarmor Capability. The Sensor Fuzed Weapon (SFW) program is an outgrowth of the Wide Area Antiarmor Munition umbrella program. This PE will accomplish full scale development of SFW.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	12,238	15,102	18,120	N/A	13,613	98,015
Other Procurement	0	0	0	N/A	Continuing	N/A

EXPLANATION: (U) FY 1986 was reduced by $691,000 due to Gramm-Rudman-Hollings reductions and by $227,000 for higher priority requirements. FY 1987 funding was increased by Congressional action to accelerate the SFW program.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

Other Procurement: 28030F						
Funds	0	0	0	111,196	3,017,014	3,028,210
Quantities	0	0	0	370	19,433	19,803

5. (U) RELATED ACTIVITIES: SFW technology support is ongoing in Program Element 62602F, Conventional Munitions; Program Element 63601F, Conventional Weapons Technology; and 64604F, Submunitions Development. Warhead, sensor, seeker, and dispenser technology programs in these program elements provide the basis for the SFW concept. Weapon concept demonstration/validation was accomplished in Program Element 63609F, Advanced Attack Weapons.

6. (U) WORK PERFORMED BY: Program management is provided by Headquarters, Air Force Systems Command, Andrews Air Force Base, MD and its subordinate organization, Armament Division, Eglin Air Force Base, FL. Contractor support for the SFW is provided by AVCO Corporation, Wilmington, MA.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION FY 1988 AND/OR FY 1989:

(U) Project: 2961, Sensor Fuzed Weapon

A. (U) Project Description: SFW is a 1000 pound cluster weapon which consists of a Tactical Munitions Dispenser (TMD) packaged with 40 armor defeating warhead mechanisms. The warhead mechanism, commonly called "Skeet", consists of a self-forging warhead and infrared detector which detects hot areas on the target and initiates the warhead. The smart cluster weapon will provide multiple kills per single aircraft pass thereby reducing aircraft/aircrew losses in attacks against armored targets.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: The SFW program completed the risk reduction program and entered Full Scale Development (FSD) in November 1985 after successfully completing the full function testing of the Skeet submunition and successful flight test of the submunition dispensing system from the TMD. A second full function test was successfully accomplished in June 1986 against operating targets.

(2) (U) FY 1987 Program: FSD continues with further submunition and TMD integration leading to nine (9) contractor tests of live all-up TMDs. After the critical design review in October 1987, qualification tests and fabrication of test hardware for Development Test and Initial Operational Test and Evaluation will begin.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: FSD will continue in FY 1988. The subsystem and system qualification testing will be completed by the contractor. Development Test and Evaluation (DT&E) and Initial Operational Test and Evaluation (IOT&E) will begin and the majority of the testing will be completed in FY 1988. DT&E will include 20 submunition (BLU-108/B) tests and 28 full Sensor Fuzed Weapon (SFW) tests from F-16, F-15E, and other tactical and strategic aircraft per the SEEK EAGLE stores certification program. Submunition tests verify the ability of the BLU-108/B to deploy the Skeet and the Skeet's performance in acquiring the target and firing the warhead. Submunition tests provide the confidence to conduct full SFW tests. IOT&E will include 36 live SFW tests from the candidate aircraft in operational mission scenarios against realistic target sets.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: DT&E will be completed in the first quarter of the year. IOT&E will be completed by the end of the second quarter. Initial procurement is also planned in FY 1989 following an Air Force Systems Acquisition Review Council IIIA in November 1988. FSD will continue throughout

the year with the implementation of Pre-Planned Product Improvements to correct problems found during DT&E and IOT&E. SEEK EAGLE testing of SFW on tactical and strategic aircraft will continue. Tasks to qualify a second source will be accomplished. The procurement program will be conducted in PE 28030F, War Readiness Material Munitions.

(5) (U) Program to Completion: FY 1989 is the last planned year for RDT&E funding.

C. (U) Major Milestones:

Milestones		Dates
(1) (U) System Demonstration Complete		December 1983
(2) (U) Risk Reduction Contract Award		July 1984
(3) (U) Full Scale Development (FSD) Start	*(September 1985)	November 1985
(4) (U) Critical Design Review	*(June 1987)	October 1987
(5) (U) Initial Production Decision	*(4th Qtr FY 1988)	November 1988

*Date presented in FY 1987 Descriptive Summary.

Explanation of Milestone Changes:

(3,4,5) (U) FSD Start, Critical Design Review, and Initial Production Decision slipped due to delays in completing the risk reduction effort, obtaining approval to proceed into FSD, and completing contractor development tests.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

Budget Activity: 4. Tactical Programs
Program Element: 64607F, Wide Area Antiarmor Munitions (WAAM)

Test and Evaluation Data

1. (U) Development Test and Evaluation (DT&E):

(U) Risk Reduction Phase: The Sensor Fuzed Weapon (SFW) risk reduction phase was accomplished to test the Tactical Munitions Dispenser (TMD) air bag dispensing system and demonstrate that design changes to the Skeet had solved the apparent fratricide problem encountered during Validation Phase testing. Design changes were successfully tested in a repeat of the full-function test in Sep 85. In the full-function test the submunition was released from a cable above the targets, the parachute was deployed and jettisoned, the rocket motor ignited, and the four Skeets were deployed above the targets. The targets were a circular array of 14 tanks. Each Skeet successfully detected and fired its slug into different tanks. The damage to two of the tanks would have constituted a mobility kill, leaving the tank immobile without significant repair. The air bag dispensing subsystem was also successfully flight tested. SFW entered full scale development in November 1985.

(U) Full Scale Development: Full scale development includes contractor subsystem and system qualification testing and Air Force DT&E/IOT&E. Contractor testing has continued with another successful full-function test of the SFW submunition against a 14 tank target array that included four operating foreign tanks. Two air bag dispensing tests were not successful. The first failure occurred because a TMD component was incorrectly assembled which prevented release of the submunitions. The problem was caused by deficient contractor quality control and not by an SFW design deficiency. The contractor has improved quality inspection procedures. The second failure was caused by the failure of TMD skin sensing switch to detect skin separation and start the submunition ejection sequence. A second switch has been added to provide redundant capability. The reports describing the results of these tests are provided in Data Item H010, Failure Summary Analysis. Contractor testing will include nine (9) all-up-round tests leading to a Critical Design Review (CDR) in July 87. DT&E is combined with the Initial Operational Test and Evaluation (IOT&E). The SFW DT&E/IOT&E testing is scheduled to be conducted during Fiscal Year (FY) 1988 and early FY 1989. The primary test objectives for this phase are to: (1) establish baseline system performance characteristics, (2) verify the predicted number of kills per pass against specified targets, and (3) determine the effect of probable countermeasures on system performance. An assessment of the system support concept in meeting logistics requirements will be made. The Air Force Operational Test and Evaluation Center will have the overall management responsibility for the IOT&E program. (Their effort is discussed in paragraph 2 below.) The combined DT&E/IOT&E program will include approximately 64 SFW all-up-round tests. All-up-round tests in IOT&E will be from candidate aircraft in operational mission scenarios against realistic target sets. The majority of the DT&E/IOT&E will be conducted at Eglin Air Force Base; however, other test ranges such as those at China Lake and Camp Drum are likely to be used. Many of the planned production processes will be used to manufacture the test hardware. System reliability, availability, and logistics support will be tested during this phase. Program management is provided by Headquarters, Air Force Systems Command, Andrews Air Force Base, MD and its subordinate organization, Armament Division, Eglin Air Force Base, FL. The Program Manager is Lieutenant Colonel Marty Runkle. Contractor SFW development, subsystem tests, and military qualification tests are being conducted by AVCO Corporation at its facility in Wilmington, MA. The majority of DT&E will be conducted by the Air Force Systems Command Armament Division.

Budget Activity: 4. Tactical Programs
Program Element: 64607F. Wide Area Antiarmor Munitions (WAAM)

2. (U) Operational Test and Evaluation (OT&E): The WAAM concept will require OT&E of the Sensor Fuzed Weapon (SFW). Air Force Operational Test and Evaluation Center (AFOTEC) has been assigned overall mansgement responsibility for SFW IOT&E program. The first phase of IOT&E, IOT&E(1) wss conducted prior to Milestone II. AFOTEC monitored contractor Demonstration and Validation (D&V) testing. The second phase of IOT&E, IOT&E(2), is conducted after Milestone II using dedicated AFOTEC test items. IOT&E(1) has been completed.

(U) Demonstration and Validation Phase. During this phase, component snd submunition development tests are conducted primarily by the contractor with some tests conducted by Air Force Systems Commsnd (AFSC) at Eglin AFB, FL. AFOTEC participated in D&V to estimate, as much as possible from the data available, the projected operational effectiveness and suitability of SFW.

(U) Full Scale Development. IOT&E(2) is being conducted by AFOTEC during FSD concurrent with DT&E. DT&E/IOT&E(2) test events will be combined where feasible. Separate IOT&E(2) will be conducted for test objectives which cannot be combined with DT&E. DT&E/IOT&E(2) is projected for FY 1987/FY 1988/FY 1989 (SFW). Common WAAM IOT&E(2) objectivea for operational effectiveness during this phase are: (1) measure the expected number of kills per pass againat armored target arrays, (2) estimate SFW performance in various battlefield and countermeasures environments, (3) estimate the ability of SFW to discriminate between real and fslse targets, (4) estimate operational reliability, and (5) estimate the effect of target location error. The operational suitability objectives include determining the availability, maintainability, reliability, and logistics supportability of the system. No unique suitability problems are anticipated snd test assets used during DT&E/IOT&E(2) will be items which are representative or production items. US Air Force personnel will operate and maintain each WAAM munition throughout each IOT&E program. Test assets programmed exclusively for IOT&E(2) are: SFW - 36 Cluster Bomb Unit rounds. At thia time specific aubayatems and support equipment requirements have not been identified. Test program requirements for each concept will be defined ss more data become avsilable.

(U) Specific test locations have not been determined for SFW. It is likely that the Eglin AFB lsnd range will be the primary test site. The Naval Weapona Center, China Lake, CA, and Ft Drum, NY are being considered. Safety will be a prime consideration in test range selection due to the large lethal footprints of the SFW.

(U) The SFW draft Test and Evaluation Master Plan is in coordination for delivery to HQ AFSC by 30 Dec 86.

3. (U) System Charscteristics: Characteristics for the Sensor Fuzed Weapon (SFW) will be definitized during the FSD phase. The primsry objectives of the program are to develop a system that csn schieve multiple kills per psss against massed armor tsrgets. Specific thresholds for the SFW system will be identified before the Air Force Systems Acquisition Review Council III.

Budget Activity: 4. Tactical Programs
Program Element: 64607. Wide Area Antiarmor Munitions (WAAM)

	Characteristic	Objective (Goal)	Demonstrated
SFW			
(U)	Target Set	Tanks, Self-Propelled Artillery, Armored Personnel Carriers, Trucks	TBD

	Characteristic	Objective (Goal)	Demonstrated
(U)	Wide Area Lethality	900 ft x 1200 ft area	TBD
(U)	Low Level Delivery	200 ft (60m)	TBD
(U)	Warhead Capability	Senior National Representatives Range Target	Target Defeated
(U)	Service Life	10 years	TBD

4. (U) Current Test and Evaluation (T&E): All Sensor Fuzed Weapon (SFW) testing to date has been conducted by the system contractor, Avco, and by the Sensor Fuzed Weapon System Program Office at Eglin AFB, FL.

T&E Activity (Past 12 Months)

Event	Planned Activity	Actual Date	Remarks
Live Full Function Test	4rd Qtr FY 86	June 1986	Successfully completed, all Skeets hit targets.
Air bag dispenser flight test	4th Qtr FY 86	Jul/Sep 1986	Submunitions failed to be ejected from TMD
Hot background single Skeet test	4th Qtr FY 86	Aug 1986	Successfully hit target with high background temperatures.

T&E Activity (Next 12 Months)

Event	Planned Date	Remarks
Live Full Function Tests	2nd/3rd Qtr FY 1987	Increased test complexity
All-up-round tests (9)	2nd/3rd Qtr FY 1987	First tests of full operational sequence

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64617F
DOD Mission Area: 225 - Air Warfare Support

Title: Air Base Survivability and Recovery
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		16,745	19,651	14,532	17,034	Continuing	N/A
2621	Rapid Runway Repair	7,700	6,500	2,800	2,900	Continuing	N/A
2895	Air Base Operability	8,041	8,921	7,662	9,641	Continuing	N/A
3141	Camouflage, Concealment, and Deception	1,004	4,230	4,070	4,493	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Sustained airfield operations are a prerequisite for a successful air campaign. Base and theater commanders must have the capability and resources to defend their main or forward airfields and to return them to operational status after sustaining an attack. This program focuses on integrating numerous ongoing efforts and providing for full-scale development for selected systems.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	19,393	21,330	19,799	N/A	Continuing	N/A
Other Procurement	56,163	73,105	106,632	N/A	Continuing	N/A

EXPLANATION: (U) FY 1986 RDT&E funding reduced by Gramm-Rudman-Hollings. FY 1987 RDT&E funding reduced by Congressional action. FY 1988 RDT&E funding reduced due to delayed contractual actions in 1986 that will cause prior year funding to be available for obligation in FY 1987 and 1988. FY 1987 Other Procurement funding reduced by Congressional action. FY 1988 Other Procurement reduced to accomodate overall Air Force budget limitations.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Other Procurement:						
Funds						
PE 12896F	79	1,440	20	528	Continuing	N/A
PE 27595F	0	0	4,110	3,137	Continuing	N/A
PE 27596F	36,053	38,316	26,764	90,763	Continuing	N/A
PE 28007F	0	127	3,753	17,369	Continuing	N/A
PE 41896F	587	1,604	2,714	7,595	Continuing	N/A
PE 72896F	61	5,939	2,316	4,512	Continuing	N/A
Quantities	Not Applicable.					
Military Construction:						
Funds						
PE 27596F	2,440	2,570	1,730	9,880	Continuing	N/A
PE 28007F	0	0	0	5,070	Continuing	N/A
PE 41896F	0	0	1,050	0	Continuing	N/A

5. (U) RELATED ACTIVITIES: This program transitions the advanced development efforts in PE 63307F, Air Base Survivability and Recovery, to Full-Scale Development. Procurement is executed through PE 12896F, Base Operations, Defensive; PE 27595F, Base Communications, Tactical Air Forces; PE 27596F, Base Operations, Tactical Forces; PE 28007F, Tactical Deception; PE 41896F, Base Operations; and PE 72896F, Base Operations (Logistics).

6. (U) WORK PERFORMED BY: Program contractors are BDM Corporation, McLean, VA (Rapid Runway Repair); Technology Applications Incorporated, Falls Church, VA (Air Base Operability); and TRACOR Aerospace Corporation, Austin, TX, and General Dynamics Corporation, Ft Worth, TX (Camouflage, Concealment and Deception). The in-house development organizations responsible for elements of the program are the Armament Division, Eglin AFB, FL; Aeronautical Systems Division, Wright-Patterson AFB, OH; the Air Force Engineering and Services Center, Tyndall AFB, FL; and the Air Force Weapons Laboratory, Kirtland AFB, NM.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 2621, Rapid Runway Repair. This full-scale development program will provide the technology, procedures, and equipment to rapidly repair large, deep craters in runways and taxiways as well as smaller, pothole sized craters caused by bombs or other enemy munitions. These functions are critical path activities which must be

accomplished before an air base can return to combat operations. The major technical thrusts are: (1) Bomb Damage Repair - develop the materials, equipment, procedures, and manuals to repair a full spectrum of conventional munitions damage. (2) Surface Roughness Criteria - determine rough field tolerance of existing aircraft and, in turn, derive surface roughness criteria which minimizes repair time. (3) Alternative Launch and Recovery Surfaces (ALRS) - develop minimum use standby surface and damage resistant pavement technology to provide a low cost alternative launch/recovery surface which can be immediately available for aircraft operations following an airfield attack. Runway repairs made with both the concrete slab and crushed-stone-with-fiberglass-cover repair techniques were tested using the C-141 and C-5 heavy airlift aircraft in early FY 1986. Major areas of future effort include crater preparation equipment, a liquid-polymer-concrete small crater-capping system and a folded fiberglass mat crater-capping system. Equipment in development or test for crater preparation includes an asphalt planer to reduce the amount of upheaved pavement to be removed (feasibility test completion in December 1986, expected to be followed by further development, operational test, and a production decision in FY 1989); a profilometer to quickly identify the limits of upheaved pavement and to control repair quality (breadboard available in October 1986 with development and test efforts continuing into FY 1989); and excavator enhancements to reduce operator training requirements (development tests to begin in mid FY 1987). Development efforts of the polymer concrete repair technique will incorporate these improvements. Completion of operational testing of the polymer concrete equipment, materials, and storage system is expected in FY 1989 with a production decision at that time. Also, a liquid polymer spall repair system is being developed as a very small, simplified material storage and placement unit used to repair pothole sized damage and is expected to be ready for procurement in FY 1989. Work on the fiberglass mat crater-capping material will result in finalization of the specifications for an air transportable repair capability (needed for Southwest Asia) for procurement in FY 1989.

B. (U) Project: 2895, Air Base Operability. Air Base Operability is a diverse group of interrelated efforts in a number of subareas. The first action on the critical path for restoration of combat operations after an enemy attack is damage assessment. In 1985 the data processing segment of the damage assessment system was demonstrated. Development of software improvements has been delayed while refining users' requirements and will be initiated in FY 1987. The data gathering segment has been delayed due to manpower constraints and will be initiated in FY 1987. The next action on the critical path is Explosive Ordnance Disposal (EOD). Improvement of today's 40-year old approach is vital. An EOD systems approach study was completed in late FY 1986. The Ordnance Rapid Clearance system prototype, intended to expeditiously clear small anti-personnel/material mines, was completed, and demonstrated, and the clearance blade assembly progressed into procurement. A Mobile Armored Reconnaissance/Operations Vehicle (MARV) has been selected from existing armored vehicles in production. The armored vehicle will be modified slightly to accommodate current EOD equipment and personnel and to carry a Standoff Munitions Disrupter (SMUD), yet to be developed. The SMUD system will provide a rapid capability to neutralize large unexploded ordnance. A competitive contract for full-scale development (FSD) of the SMUD will be awarded in FY 1987 to be completed in FY 1988. Advanced development of an F-16 ground mobility system was completed in FY 1986, with approval for FSD pending user review in mid FY 1987. Studies of generic mobility equipment for other aircraft are to be completed in mid FY 1987, with FSD to start in early FY 1988 and complete in FY 1990. FSD will begin in FY 1987 on a Foreign Object Damage avoidance device for F-16 aircraft, with procurement to start in FY 1990. Development of a portable airfield lighting system to outline the Minimum Operating Strip and provide visual approach course and glide path guidance will begin in FY 1988 and be completed in FY 1990. A

study and test effort to cheaply and quickly reinforce existing aircraft shelters against 30 millimeter aircraft cannon strafing will be completed in November 1986 with the interim report published in December 1986. A hardened Local Area Network (LAN) with software tailored to an air base's data communication needs will enter full-scale development (FSD) in FY 1988 following advanced development efforts in FY 1986 and FY 1987. This will provide improved survivable communications within the base to enable better coordination of activities during air base recovery after attack. This survivable LAN and data communication development will be completed in late FY 1990.

C. (U) Project: 3141, Camouflage, Concealment, and Deception (CCD). This project embraces the full spectrum of CCD methods to mitigate the effectiveness of enemy attacks against airfields. The project includes development of aircraft decoys, atmospheric obscuration concepts, and sensor deception (optical and radio frequency). Most of the CCD efforts in FY 1986 have been in advanced development, funded under PE 63307F, Air Base Survivability and Recovery. FSD of CCD has been delayed due to manpower constraints, resulting in a slip in the contract award date for F-15 and F-16 aircraft decoy development now planned for FY 1987. Operational testing of the decoys will be conducted in FY 1988 followed by a production decision. Follow-on development of decoys for other aircraft will continue through FY 1988 culminating in decoy development completion in FY 1989. Development of radar reflective devices for deception of enemy aircraft radars will start in FY 1988 with testing completed in FY 1989. The development of lightweight camouflage nets, large area canopy shelters, large area smoke screen capability, and surface-to-air missile simulators is expected to begin in mid FY 1988. Development completion and testing of these items is expected in FY 1990. The development of false operating surfaces will begin in early FY 1989 and be completed in FY 1990. Efforts that will focus on capabilities for electronic, infrared, and ultraviolet sensor deception are addressed in CCD II. The FSD for CCD II will begin in FY 1990 as portions of the advanced development study funded in PE 63307F are completed. CCD II will continue into FY 1992.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64703F
DOD Mission Area: 255 - Air Warfare Support

Title: Aeromedical/Chemical Defense Systems
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	4,736	8,063	6,730	8,103	Continuing	N/A
2866	Aeromedical/Chemical Defense Systems	4,736	8,063	6,730	8,103	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Air Force has limited capability to treat and evacuate wartime casualties from a chemical or conventional warfare environment and no adequate means of improving this capability. This program will develop, produce and deploy field medical equipment/systems for the treatment and evacuation of wartime casualties in a chemical or conventional warfare environment. It will also provide tactical and strategic aeromedical evacuation systems and Air Force unique field medical treatment equipment (second and third echelon medical units) required to fulfill Department of Defense and Air Force needs.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	7,844	9,341	8,873	N/A	Continuing	N/A

EXPLANATION: (U) The reductions resulted from Department of Defense reprogramming actions, adjustment for inflation, and funds for the Small Business Innovative Research Program.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: This program is coordinated and reviewed via the Joint Service Review Group for Chemical Warfare and by the Armed Services Biomedical Research and Evaluation Management Committee. Only efforts unique to the Air Force (Tactical and Strategic Aeromedical Evacuation and the Air Force Medical Four Echelon System) are addressed in this program. PE 63231F, Crew Systems and Personnel Protection Technology, will transfer advanced development efforts of Air Force unique requirements to this program. In addition, a Memorandum of Agreement was established with the U.S. Army Medical Research and Development Command to jointly pursue some of these programs in accordance with the Joint Service Agreement. Internationally this program is coordinated through the NATO/Military Agency for Standardization. Air Force operational commands are involved throughout the development process.

6. (U) WORK PERFORMED BY: This program is conducted by the Aeromedical/Casualty System Program Office, Aerospace Medical Division, Brooks AFB, TX. Integrated Logistics Support is provided by Air Force Logistics Command and the Air Force Office of Medical Support. The contract portion of the program is conducted by Essex Cryogenics of Missouri,

St Louis, MO (Portable Therapeutic Liquid Oxygen System); Krug International, San Antonio, TX, and Dayton, OH (Therapeutic Oxygen Manifold System and Transportable Airborne Therapeutic Station); ILC Dover, Frederica, DE (Chemical Casualty Coveralls and Intravenous Protection); Systems Research Laboratories, Dayton, OH (Survivable Collective Protection System-Medical); and Technical Services Laboratory, Ft Walton Beach, FL (Electrical Cable Assembly Sets).

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2866, Aeromedical/Chemical Defense Systems

A. (U) Project Description: This project develops medical equipment and systems for treatment and evacuation of wartime casualties in a chemical or conventional warfare environment. It also provides tactical and strategic aeromedical evacuation systems, blood transshipment capabilities, and field medical treatment equipment (second and third echelon medical units) to fulfill Department of Defense and Air Force operational requirements. The introduction of chemical warfare into a conventional conflict will significantly increase casualty rates and limit the effectiveness of the Air Force medical mission. Urgent requirements identified by the Major Commands for the treatment and evacuation of wartime casualties are the basis for the program. The ability to isolate the casualties from further chemical agent contamination, to allow medical personnel to render effective treatment under these conditions, and to adequately transport the casualties are essential to the success of the Air Force medical mission.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: A major accomplishment of the system program office was the award of its first production option in February 1986 for the Electrical Cable Assembly Sets, with first deliveries in August 1986. The contract for full scale development of the Transportable Airborne Therapeutic Station was awarded in June 1986. The contract for full scale development of the Survivable Collective Protection System-Medical (SCPS-M) was awarded in July 1986. System level concept demonstration for Osan Air Base Hospital Contamination Control Area (CCA) was completed in September. Feasibility study for Chemically Hardened Air Transportable Hospital was completed in August. Efforts currently in progress for SCPS-M include the Patient Processing Study and the CCA Design Study. Full-scale development will continue on Patient Aeromedical Communication System, Aeromedical Evacuation Lights, Casualty Coveralls, Chemical Warfare Equipment Cover, and Chemical Warfare Hardened First Aid Kits. Solicitation proposals are in progress for Civil Reserve Air Fleet Aeromedical Evacuation Shipsets, Personnel and Equipment Contamination Sensor, and Transportable Blood Transshipment Center.

(2) (U) FY 1987 Program: The FY 1987 program includes the System Program Office's first program management responsibility transfer with the Electrical Cable Assembly Sets' October 1986 transfer to Sacramento Air Logistics Center. Award of production option for Portable Therapeutic Liquid Oxygen and for Therapeutic Oxygen Manifold System is anticipated in December 1986. Production is scheduled on the Transportable Airborne Therapeutic Station. Operational Test and Evaluation will occur on the Casualty Coveralls. Full scale development will continue on the Survivable Collective Protection System-Medical (SCPS-M), Patient Aeromedical Communication System, and Aeromedical Evacuation Lights (AEL). Full scale development contract award for Osan AB Hospital Contamination Control Area (CCA)

is scheduled for February 1987.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The FY 1988 program will include production of the AEL and Operational Test and Evaluation of the Osan CCA and SCPS-M. The Osan CCA when installed and integrated with the existing hospital chemical-biological filtration system and utilities, will allow chemical decontamination and processing of both litter and ambulatory patients into the medical facility. The Osan CCA and its associated data package will be the prototype for development of other hospital designated CCAs. The SCPS-M will provide the capability to perform second echelon (2E) medical care on base, near areas of greatest casualty generation or population density, in both chemical and conventional warfare environments. Currently, the Air Force medical community must perform 2E care off base in a chemically clean area. An on-base capability will result in more expedient treatment of casualties and a shorter return-to-duty time of minimally injured patients, eliminating the logistics, transportation, and security problems associated with the current off-base location. Full scale development will be accomplished on Civil Reserve Air Fleet (CRAF) Aeromedical Evaluation (AE) Shipsets. The CRAF AE shipsets provide the equipment necessary to configure 85 Boeing 767 and 30 McDonnell-Douglas 80 civilian aircraft to meet tri-service needs for wartime aeromedical evacuation.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The FY 1989 program will include production of the Casualty Coveralls, the SCPS-M, the Chemically Hardened First Aid Kit, the Chemical Warfare Equipment Cover, and the Patient/Attendant Communication System. Full scale development will be completed and production will begin on the CRAF AE Shipsets. Full scale development will begin on the Multipurpose Ventilator, Personnel and Equipment Contamination Sensor (PECOS), and the Transportable Blood Transshipment Center (TBTC). The Multipurpose Ventilator is a lightweight, portable, simple to operate system capable of operating in a chemical warfare environment and is needed to preserve life until the patient's ventilatory problems can be medically resolved. This ventilator will be used in the field, 2E medical facilities, and during the aeromedical evacuation mission. The PECOS is a device for detection and location of chemical agents on personnel and equipment. The system will be used at SCPS-M and other collective protection shelters, on board aeromedical evacuation aircraft, and in operational line work centers. The PECOS will identify contaminated personnel and equipment and will facilitate the use of time saving procedures for personnel and equipment with no contamination. The TBTC is an Air Force lead agent responsibility which will provide blood freezing, storage, and transshipment capability worldwide. Currently, blood can only be stored for 35 days. With TBTC, processed frozen blood can be received, re-iced, and stored for 21 years prior to shipment, greatly improving the capability of the Armed Services Blood Distribution System.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones:

Milestones		Dates
(1) (U) Survivable Collective Protection System-Medical (SCPS-M)-Development Contract Award	*(2nd Qtr FY 86)	July 1986

Milestones		Dates
(2) (U) Portable Therapeutic Liquid Oxygen System (PTLOX)-Production Decision	*(2nd Qtr FY 86)	November 1986
(3) (U) Therapeutic Oxygen Manifold System (TOMS)-Production Decision	*(2nd Qtr FY 86)	November 1986
(4) (U) Osan AB Hospital Contamination Control Area-Development Contract Award		February 1987
(5) (U) Ambulatory Casualty Chemical Warfare Suit and Intravenous System-Production Decision		June 1987
(6) (U) Chemically Hardened First Aid Kit-Production Decision		June 1987
(7) (U) Civil Reserve Air Fleet (CRAF) Aeromedical Evacuation (AE) Kits-Development Contract Award	*(2nd Qtr FY 87)	November 1987
(8) (U) Transportable Airborne Therapeutic Station (TATS)-Production Decision	*(1st Qtr FY 87)	August 1987
(9) (U) Patient Ventilator-Contract Award	*(1st Qtr FY 87)	October 1988
(10) (U) Transportable Blood Transshipment Center-Initiate Development	*(1st Qtr FY 87)	January 1989

*Date presented in FY 1987 Descriptive Summary.

(U) Explanation of Milestone Changes:

(1) (U) The SCPS-M contract award slipped 90 days due to delays in proposal evaluation and committee review.
(2) (U) The PTLOX production decision delayed due to correction of Operational Test and Evaluation (OT&E) deficiencies.
(3) (U) The TOMS slipped 90 days because OT&E units were delayed due to Development Test and Evaluation DT&E problems; additional 30 day slip due to delays in drawing approval.
(7) (U) The CRAF AE Kits slipped 90 days due to revision in funding estimate which breached threshold requirement for an acquisition plan. An additional slip of 150 days is due to contract negotiation issues and acquisition strategy revisions also subsequent to repricing.
(8) (U) The TATS delayed because user requested change in specifications after the contractor's original proposal was submitted.
(9) (U) The Patient Ventilator contract award slipped one year due to Defense Resources Board budget reduction.
(10) (U) Transportable Blood Transshipment Center (TBTC) delayed due to Defense Resources Board budget reduction.

8. (U) PROJECTS OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64704F
DOD Mission Area: 225 - Air Warfare Support

Title: Common Support Equipment
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		0*	0*	1,645	2,237	Continuing	N/A
2479	Common Support Equipment Development	0*	0*	1,645	2,237	Continuing	N/A

* FY 1986 and FY 1987 funding are contained in PE 64708F, Other Operational Equipment.

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program develops, tests, evaluates and fields improvements to flightline, base level, and depot level support equipment. Its goal is to limit proliferation, increase standardization, performance, availability, and reliability/maintainability, thereby reducing life cycle costs. Special needs of various theaters of operation, including those peculiar to the Rapid Deployment Forces, are addressed.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: Not Applicable.

EXPLANATION: (U) Funding was contained in PE 64708F, Other Operational Equipment.

4. (U) OTHER APPROPRIATION FUNDS: Other Procurement Funding Source: BP 1200. Common Aerospace Ground Equipment related to Project 2479, Common Support Equipment Development.

5. (U) RELATED ACTIVITIES: Close cooperation is maintained with other services via the Joint Logistics Commanders Panel on Support Equipment and this same cooperation is maintained with the Major Commands via the Aircraft Ground Support Equipment Working Group (AGSEWG) and the Air Force Nondestructive Inspection (NDI) Program Office.

6. (U) WORK PERFORMED BY: The primary contractors are Libby Corporation, Kansas City, MO, and Standard Manufacturing, Dallas, TX. The in-house developing organization is Air Force Systems Command's Aeronautical Systems Division, Wright-Patterson AFB, OH.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

PE: 64704F

Program Element: 64704F
DOD Mission Area: 225 - Air Warfare Support

Title: Common Support Equipment
Budget Activity: 4 - Tactical Programs

(U) Project: 64704F, Common Support Equipment

A. (U) Project Description: This project develops standardized flightline ground support equipment that's more effective, has a lower life cycle cost, and has a greater return on investment than current support equipment. The Large Aircraft Start System (LASS) will replace the air cart for the unsupportable MA-1A air start cart and the A/M32A-60A generator. The Universal Aircraft Towbar (UAT) program will develop a set of standardized towbars for towing aircraft having gross weights of less than 325,000 pounds. The Standard Hydraulic Test Stand (SHTS) will develop a standard three system electric and diesel engine driven hydraulic test stand which will support all aircraft in production or planned. It will replace, on an attrition basis, approximately 30 different types of hydraulic test stands presently in the inventory. The Advanced X-Ray System project will develop a rugged, high resolution X-Ray system for field nondestructive detection of structural flaws, foreign substances, and corrosion in inaccessible components of aircraft, engines, and missiles.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: The FY 1986 program (funded in PE 64708F, Other Operational Equipment) completed follow-on test and evaluation of the prototype UATs, completed test and evaluation of the prototype LASS carts, and initiated LASS production.

(2) (U) FY 1987 Program: The FY 1987 program (funded in PE 64708F, Other Operational Equipment) will initiate production of the UATs. Development effort on the SHTS program will begin.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The FY 1988 program will continue development test and evaluation on the SHTS. Development will start on the Advanced X-Ray System.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The FY 1989 program will perform Initial Operational Test and Evaluation of the SHTS followed by a production decision. Development and test of the Advanced X-ray System will continue.

(5) (U) Program to Completion: This is a continuing program for the development of flightline, base level, and depot level support equipment.

C. (U) MAJOR MILESTONES: Not Applicable.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64706F
DOD Mission Area: 225 - Air Warfare Support

Title: Life Support System
Budget Activity: 4 - Tacticel Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands):

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		17,006	14,879	12,617	15,730	Continuing	N/A
412A	Life Support Systems	13,517	13,271	7,103	10,282	Continuing	N/A
3111	Aircraft Mishap Prevention Program	489	1,608	3,099	2,448	1,161	8,805
2952	F-111 Cluster Parachute	3,000	0	2,415	3,000	6,245	14,660

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This is the only Air Force program element devoted to engineering development of life support equipment and contains a number of joint service endeavors. Project 412A provides for centralized management and full-scale development of life support equipment and subsystems necessary to assure functional capability of aircrews throughout all mission environments and to enhance safe escape, descent, survival, and recovery in emergency situations. It also provides for development, test, and standardization of emergency equipment and protective clothing and devices for non-flying personnel. Project 3111 will develop a data base and management information system to reduce loss of aircrew lives and aircraft due to human error. Project 2952 is a safety modification to the parachute system of the F-111 Crew Escape Module to lower descent velocity and thereby reduce the frequency and severity of spinal injuries to ejecting crew members.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	15,272	12,396	20,432	N/A	Continuing	N/A

EXPLANATION (U): In FY 1986, $3.0 million was reprogrammed into the program element for the F-111 Cluster Parachute Project. In FY 1987, Congress added $3 million for the Tactical Life Support System. In FY 1988, $7.8 million was transferred out of the program element to support higher priority projects.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: There are several program elements which provide exploratory/advanced development and contribute to full-scale development of life support equipment. Some representative program elements are PE 62201F, Aerospace Flight Dynamics; PE 62202F, Aerospace Biotechnology; PE 63211F, Aerospace Structures/Materials; PE 63231F, Crew Systems and Personnel Protection Technology; PE 62723A, Clothing, Equipment and Shelter Technology; PE 64204A, Air Mobility Support Equipment; PE 62241N, Ejection Seat Bio-Dynamics; PE 62758N, Biomedical Technology; and PE 63216N, Mission Oriented Clothing and Devices. All efforts within this program are closely coordinated with the other services via a formal Tri-Service steering committee, established in 1980 to promote standardization and prevent duplication of effort.

6. (U) WORK PERFORMED BY: Air Force Systems Command's (AFSC) Aeronautical Systems Division (ASD), Wright-Patterson AFB, OH, manages Project 412A. Support is also provided by other Service organizations, such as the Army Natick Research and Development Command, Natick, MA; Naval Ordnance Station, Indian Head, MD; and Naval Air Development Center, Warminster, PA. ASD had 16 major contractors in FY 1986, including Douglas Aircraft Company, Long Beach, CA; Motorola, Phoenix, AZ; and Gentex, Carbondale, PA. The total value of Life Support R&D contracts is approximately $12 million. AFSC's Aerospace Medical Division, Brooks AFB, TX, manages Project 3111. Battelle Columbus Laboratories, Columbus, OH, was one of three project contractors in FY 1986. ASD manages Project 2952, but the work is performed by Air Force Logistics Command's (AFLC) Sacramento Air Logistics Center (ALC), McClellan AFB, CA. General Dynamics Corporation, Fort Worth, TX is one of the two contractors, and the project is also supported by the National Aeronautics and Space Administration, Dryden Flight Research Facility, Edwards, CA.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 3111, Aircraft Mishap Prevention Program (AMPP). This project develops and demonstrates a data base and information management system to reduce loss of aircraft and aircrew lives due to human factors or errors. It establishes an Air Force-wide mishap and near-mishap reporting system tailored to provide detailed data on human factors problems for direct command-level access, to aircraft system project offices for design change recommendations, to the R&D and engineering community for identifying R&D needs to the laboratories, and to the safety community for compiling mishap statistics. FY 1986 accomplishments include completion of the acquisition plan, site selection, and manpower and hardware design studies. FY 1987 will see contract award and initial acquisition of computer hardware and software. The primary activities in FY 1988 will be the refinement and update of the prototype software, data collection, and the development of user application scenarios. These tasks extend into FY 1989. Also in FY 1989, the development of an Operations Impact Model to track implemented solutions and to provide a measure of return-on-investment will take place. In-house training programs will be developed and development test and evaluation conducted. A system demonstration, as well as operational test and evaluation, will occur in FY 1990. Prior to a decision to transition AMPP to operational use, a fielding demonstration of the system at the command level and an analysis of program payoff will be made. In FY 1991, the functioning program will be transferred to the Air Force Inspection and Safety Center, Norton AFB, CA.

B. (U) Project: 2952, F-111 Cluster Parachute. The goal of this project is to reduce the frequency and severity of spinal injuries incurred by ejecting F-111 crew members when the Crew Escape Module (CEM) impacts the ground. This is achieved by replacing the current single-canopy parachute on the CEM by a cluster of three parachutes, thereby lowering impact velocity. Prior efforts included the selection of a cluster parachute as the design solution, detailed design of the cluster parachute, and proof-of-design testing. FY 1986-1989 work consists of CEM-parachute integration and testing. Design integration began in FY 1986. Planned FY 1987 efforts include captive crew module tests at Sandia National Laboratories, Albuquerque, NM, air drop tests at the Air Force Flight Test Center, Edwards AFB, CA, and rocket sled ejection tests at Holloman AFB, NM. Both the air drop and ejection tests will continue throughout FY 1988 and into FY 1989, culminating in the release of technical data that will initiate the actual safety modification to the F-111/FB-111 CEM.

8. (U) PROJECTS OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 412A, Life Support Systems.

A. Project Description: Provides centralized development of Air Force Life Support equipment and subsystems as well as selected items of joint service equipment. Satisfies operational command requirements for improved Life Support equipment to maximize aircrew capability throughout all environments, and to enhance safe escape, descent, survival, and recovery in emergency situations. Also provides for development, test, and standardization of emergency equipment and protective clothing and devices for non-flying personnel.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: In FY 1986, the Life Support System Program Office continued several ongoing developments. Three projects seek to prevent the drowning of disabled pilots who eject over water: (1) the LPU-9/P Automatic Life Preserver, which completed testing and began production; (2) the Seawater Activated Release System parachute release, which also completed testing and began production; and (3) the Aircrew Anti-Drown System, a water-activated, oxygen-mask-release device, which began development test and evaluation (DT&E). Two projects designed to preclude pilot loss of consciousness due to high accelerations (i.e., G-forces) continued: (1) DT&E was conducted on four anti-G pressure suit valves, all of which are candidate designs for a follow-on improvement to the High-Flow Anti-G Valve, currently in production; and (2) Positive Pressure Breathing, a system which facilitates breathing under high-G conditions and thereby reduces pilot fatigue due to G-forces, was integrated into the F-16 in preparation for a flight demonstration. Operational test and evaluation (OT&E) of an improved microphone for the MBU-12/P Oxygen Mask was completed. Specifications and data necessary for procurement of a Cold Weather Flight Coverall were completed. A developmental request for proposal for a Cold Weather Flying Boot was prepared. DT&E of the Cold Weather Sleeping Bag and the Vacuum-Packed One-Man Life Raft was conducted. Flight tests of a Noise Reduction Earcup were conducted. Work began on a procurement request package for a Multi-Place Life Raft. Several modifications to increase the performance envelope of the Advanced Concept Ejection Seat II, the ejection seat used on the A-10, F-15, F-16, and B-1B aircraft, continued. One of these modifications, the Automatic Inflation Modulation Parachute, a joint US-Canadian development,

underwater drop tests as a step toward Advanced Concept Ejection Seat (ACES) II qualification. Another, the Advanced Recovery Sequencer (ARS), a device to control parachute deployment and man-seat separation, entered Full-Scale Development (FSD). A study of the stability of the ACES II when ejecting lightweight aircrew members, initiated in FY 1985, continued in FY 1986 with center-of-gravity testing and computer modeling.

(2) (U) FY 1987 Program: In FY 1987, the Aircrew Anti-Drown System will enter FSD, including Initial Operational Test and Evaluation (IOT&E). FSD of a follow-on anti-G valve will begin. The Positive Pressure Breathing (PPB) System will be demonstrated on the F-16 and begin FSD. Both the Cold Weather Flying Boot and the Noise Reduction Earcup will enter FSD. Both the Cold Weather Sleeping Bag and the Vacuum-Packed One-Man Life Raft will undergo IOT&E, and production specifications will be finalized. The procurement request package for the Multi-Place Life Raft will be completed, and FSD will begin. The Automatic Inflation Modulation (AIM) Parachute and the ARS will undergo sled testing with the ACES II, and the development of a Restraint Emergency Release (RER) System for the ACES II will begin. The Tactical Life Support System (TLSS), which consists of an Anti-G System, aircrew Laser Eye Protection, Night Vision Goggles for aircrews, and aircrew nuclear flash-blindness protection (PLZT Goggles), will transition to FSD. Other new projects include the Universal Seawater Activated Release System (SEAWARS), a seawater activated release system for man-carried parachutes, and the Survivor Location System, a radio beacon interrogator-transponder which precisely locates downed airmen in a hostile environment.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The Aircrew Anti-Drown System will complete FSD and enter production. FSD of a follow-on anti-G valve will be completed, and OT&E will take place. FSD of PPB will be completed. IOT&E will be conducted and a production decision made for the Cold Weather Flying Boot. OT&E will be completed and a production contract awarded for the Noise Reduction Earcup. OT&E of the Multi-Place Life Raft will begin. Production of the AIM Parachute and the ACES II ARS will begin. Testing of the RER System for the ACES II will be conducted, leading to a production decision. Development of the Tactical Life Support System (TLSS), Universal SEAWARS, and the Survivor Location System will continue.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: In FY 1989, initial operating capability of the Aircrew Anti-Drown System will be attained. Crew Escape Systems Technology will transition to FSD from PE 63231F, Crew Systems and Personnel Protection Technology, and development of the Molecular Sieve Oxygen Generating System, an oxygen generator that is installed on board aircraft, will begin. Other ongoing developments, including TLSS, Universal SEAWARS, and the Survivor Location System, will continue. Cost estimates are based on detailed implementation plans prepared by field agencies each year and are a mixture of fixed price contracts, grass roots, and parametric estimates. This program contains 24 different tasks, including cost categories I, II, III, and IV.

(5) (U) Program to Completion: This is a continuing program. Full-scale development efforts will be initiated based on the Life Support Master Development Plan, which identifies and integrates Life Support development efforts for the next 10 years.

C. (U) Major Milestones: Not Applicable.

Program Element: 64706F Title: Life Support System
DOD Mission Area: 225 - Air Warfare Support Budget Activity: 4 - Tactical Programs

9. (U) COOPERATIVE AGREEMENTS:

(U) Automatic Inflation Modulation (AIM) Parachute: The AIM Parachute is a joint US-Canadian venture to improve the performance of the Advanced Concept Ejection Seat (ACES) II through development of a parachute which has improved reliability and the capability to deploy at higher speeds, thereby lowering the minimum altitude for safe ejection. The cooperative agreement between the US and Canada provides for 50-50 sharing of the cost of parachute development, which began in 1978 and was completed in November 1982 at a total cost of $1.2 million for the US and $0.6 million for Canada. (Costs were not equal because the US contracted for some unique requirements.) The US pays the full cost of the subsequent ACES II integration and system-level qualification, which were contracted for through a modification to the original 1978 parachute development contract. The contractor is Irvin Industries Canada, Ltd., Fort Erie, ON, although the Life Support System Program Office contracts directly with the Canadian Government (Canadian Commercial Corporation, Ottawa, ON). US costs for ACES II integration and system-level qualification, which began in March 1984, have been $0.3 million in FY 1984, $0.3 million in FY 1985, and $0.8 million in FY 1986. Projected costs to completion are $0.4 million for FY 1987 and $0.1 million in FY 1988. The cooperative agreement also provides for co-production. Specifically, if the Canadian bid is within 117 percent of the winning US industry bid, Canada will get half the production, up to 13,000 units annually.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64708F
DOD Mission Area: 225 - Air Warfare Support

Title: Other Operational Equipment
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		12,555	13,753	6,987	6,748	Continuing	N/A
2054	Aerospace Facilities Engineering Development	1,713	2,815	1,466	1,120	Continuing	N/A
2479	Common Support Equipment Development	201	1,298	0*	0*	Continuing	N/A
2505	Aircraft Fire Fighting, Suppression and Rescue	980	980	1,250	1,240	Continuing	N/A
2674	Tactical Shelters	2,297	1,500	1,880	1,217	Continuing	N/A
2783	Ground Power Generator Development	2,828	3,900	0	0	0	35,400
3080	Generic Integrated Maintenance Diagnostics	4,536	3,260	2,391	3,171	Continuing	N/A

* Beginning in FY 1988, funding for Project 2479, Common Support Equipment Development, is in PE 64704F, Common Support Equipment.

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program develops, tests, and evaluates improvements to flightline common support equipment, tactical shelters, and fire fighting equipment and methods, pollution monitoring equipment, air base facilities, and aircraft diagnostics/test systems. Special needs of various theaters of operation, including those peculiar to the Rapid Deployment Forces, are addressed.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	15,574	14,469	9,869	N/A	Continuing	N/A

EXPLANATION: (U) The change in FY 1986 was caused by a delay in the testing of the ground power generators in Project 2783, Ground Power Generator Development and reprogramming to higher Air Force priority programs. The change in FY 1988 was caused by two actions: a transfer of Project 2479, Common Support Equipment Development, to a new Program Element, PE 64704F, Common Support Equipment, and a rephasing of Project 3080, Generic Integrated Maintenance Diagnostics

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: PE 63723F, Civil and Environmental Engineering Technology, provides advanced development for projects 2054 and 2505. Close cooperation is maintained with other services via the Joint Logistics Commanders Panel on Support Equipment, the Joint Committee on Tactical Shelters and the Joint Services Civil Engineering Research and Development Coordinating Group.

6. (U) WORK PERFORMED BY: The primary contractors are Teledyne Continental Motors, Mobile, AL, and Ingersoll Rand, Mocksville, NC (both for project 2783, Ground Power Generator Development); University of New Mexico Research Institute, the Department of Energy, Idaho Operations Office and AMETEK, Inc, Off Shore Research and Engineering Division, Santa Barbara, CA (for project 2505, Fire Fighting, Suppression and Rescue and project 2054, Aerospace Facilities Engineering Development). The in-house developing organizations are: for projects 2479, 2783, and 3080, the Air Force Systems Command, Aeronautical Systems Division, Wright-Patterson AFB, OH; for projects 2054 and 2505, the Air Force Engineering and Service Center, Tyndall AFB, FL; and for project 2674, Air Force Systems Command, Electronic Systems Division, Hanscom AFB, MA.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 2054, Aerospace Facilities Engineering Development. This project addresses the development of equipment, materials, and procedures necessary to improve the operational effectiveness of aerospace facilities and to assure the Air Force meets Environmental Protection Agency standards. In 1986, efforts continued to develop ways for reducing air base pollution; to develop methods for determining the presence, concentration, and movement of toxic pollutants in Air Force facilities' environs; to validate designs of valves, walls, and doors on existing semihardened personnel shelters; and to validate asphaltic concrete recycling techniques. In FY 1987, the program will complete validation of design criteria for semihardened walls, blast doors, and blast valves for protective facilities, and validation of the selection criteria for asphaltic concrete recycling agent. Additionally, the FY 1987 program will conduct Development Test and Evaluation/Initial Operational Test and Evaluation on the Radioluminescent Portable Airfield Lighting for the Alaskan Air Command cold weather requirement. The FY 1988 program will conclude nondestructive pavement testing equipment development. In addition, a rut resistant pavement material program will be established. Shelter wall materials will be blast tested and construction techniques evaluated. We will also evaluate an innovative air stripping technique for removing volatile organic compounds. Finally, we will evaluate external monitoring devices for detecting leaks in underground JP4 storage tanks. Survivable utilities design and repair and hardened design efforts will be initiated in FY 1989. In addition, the protective upgrade of facilities work will continue and the rut resistance cement mix design project will be completed.

B. (U) Project: 2505, Fire Fighting, Suppression, and Rescue. This project develops improved fire fighting, suppression and rescue equipment, materials, and methods to improve Air Force fire protection effectiveness, mobility, and wartime readiness. The FY 1986 program continued development of a capability to combat fires in a chemical warfare

environment which included National Institute of Occupational Safety and Health certification of both the chemical warfare communications helmet and a two hour self-contained breathing apparatus. Additionally, the FY 1986 program developed and tested a Capsulized Fire Extinguisher device for stove tops in kitchens. The FY 1987 program will begin full scale development of a rescue vehicle and development of a situation simulator for hose line operations. The FY 1988 program will conclude efforts on aircraft hot pit fire protection and the aircraft fire fighting situation simulator. Development will continue on the improved Tactical Air Forces rescue vehicle. Full scale development will begin on the aircraft robot fire sentry and on the air cushion aircraft crash rescue vehicle. In FY 1989, hydrazine fire fighting agent, chemical warfare ensemble operational test and evaluation, and infrared guided turret project will be initiated. Improved training procedures evaluation will continue and the Tactical Air Forces rescue vehicle and combination ensemble will be completed.

C. (U) Project: 2674, Tactical Shelters. This project provides for development and acquisition support of tactical shelter systems. There is a need to improve and standardize tactical shelter designs. The FY 1986 program continued the development of the International Organization for Standardization (ISO) adapter pallet, chemical warfare hardening kits for shelters, the development of a mobile tactical shelter to be used on the High Mobility Multi-Wheeled Vehicle/Common Utility Cargo Vehicle (HMMWV/CUCV) vehicles. The FY 1987 program will develop the ISO loading jack system, reliability and maintainability documentation program, continue development of improved shelter materials, develop an electromagnetic pulse simulator, and conclude the chemical warfare hardening kits program. The FY 1988 program will continue the add-on armor program for ballistic protection at a low level of effort, initiate shaped shelters program, and continue electromagnetic pulse protection efforts with Harry Diamond Laboratories. In FY 1989, we will continue the shaped shelters program, begin the study of a nuclear overpressure hardened shelter, and complete the evaluation of shielding effectiveness.

D. (U) Project: 3080, Generic Integrated Maintenance Diagnostics (GIMADS). GIMADS will provide generic, expandable, integrated maintenance diagnostics methods and standards. Early demonstration of GIMADS on the B-1B will increase the experience base. The overall purpose is to provide cost effective capabilities to the weapon system designer to build-in 100 percent fault detection and isolation to the line-replaceable-unit/module and provide maintenance techniques and retrofit capability for Air Force weapon systems. The FY 1986 program supported a contract awarded for the B-1B Centralized Integrated Test System Expert Parameter System. The program was restructured to emphasize technology transition/demonstration and integration and add the prognostics and non-electronics areas. The FY 1987 program will award contracts for component integration. A close working relationship is being developed with the Navy through the Panel on Integrated Diagnostics of the Joint Logistics Commanders' Joint Policy Coordinating Group for Logistics Research, Development, Test, and Evaluation. The GIMADS program implements recommendations of the National Academy of Science's Air Force Studies Board Summer Study (1985), and capitalizes on products from the National Security Industrial Associations's (NSIA) Working Group on Integrated Diagnostics, and supports Office of the Secretary of Defense (OSD) chaired activities on fault isolation and diagnostics. In FY 1988, the B-1B items will be completed and the generic portion of the project will continue with incremental implementation of the techniques and methodologies to weapon system acquisitions. In FY 1989, techniques and methodologies for avionics prognostics and non-electronics fault isolation will be redefined and integrated with continuing application to weapon system acquisitions.

Program Element: 64708F
DOD Mission Area: 225 - Air Warfare Support

Title: Other Operational Equipment
Budget Activity: 4 - Tactical Programs

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64710F
DOD Mission Area: 327 - TIARA for Tactical Air Warfare

Title: Reconnaissance Equipment
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		7,059	9,222	195	203	Continuing	N/A
1155	Electro-Optical Collection/ Reconnaissance (COMPASS SEVEN)	4,159	6,522	0	0	0	11,131
2704	Tactical Electronic Reconnaissance (TEREC)	2,900	2,700	195	203	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Projects in this program element support Air Force and other agencies' reconnaissance/intelligence collection requirements. Through FY 1987, COMPASS SEVEN provides engineering development of airborne and ground sensors (with associated equipment) used to collect, record, and process imagery and electronic warfare data. Certain efforts develop unique intelligence gathering sensor systems for one-of-a-kind tasks. These are Science and Technology programs. TEREC supports theater commanders by providing tactical reconnaissance information about enemy threat radars in near-real time.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	7,621	9,540	10,200	N/A	Continuing	N/A

EXPLANATION: (U) Science and Technology programs are no longer funded in this Program Element.

4. (U) OTHER APPROPRIATION FUNDS: Not applicable.

5. (U) RELATED ACTIVITIES: PE 63203F, Advanced Offensive Avionics, and PE 63208F, Reconnaissance Sensors/Processing Technology, provide advanced development technology inputs to this program element. Procurement funds for new sensors and/or aircraft modifications resulting from this program--such as the Tactical Electronic Reconnaissance (TEREC) System--are provided by PE 27213F, RF-4C Squadrons. Air Force Logistics Command provides support for special aircraft modifications for PE 64710F projects. All projects in this program element are coordinated with the Major Commands and/or the National Security Agency groups directly involved.

Program Element: 64710F Title: Reconnaissance Equipment
DOD Mission Area: 327 - TIARA for Tactical Air Warfare Budget Activity: 4 - Tactical Programs

6. WORK PERFORMED BY: Texas Instruments, Dallas, TX (TEREC Remote Terminals, Project 2704); AMECOM/Division of Litton Industries, College Park, MD (TEREC airborne sensors, Project 2704); Fairchild-Weston, Syosset, NY (electro-optical systems, Project 1155); Vought Systems Division, Grand Prairie, TX, (electro-optical systems, Project 1155); and[ ] Responsible agency of the Air Force Systems Command is the Aeronautical Systems Division, Wright-Patterson AFB, OH.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2704, Tactical Electronic Reconnaissance (TEREC)

A. (U) Project Description: The TEREC system directly supports theater commanders by accurately detecting, identifying, and locating threat radars. TEREC is operated by the Tactical Air Forces as part of the tactical reconnaissance mission. There are currently 22 collection platforms (modified RF-4C aircraft) plus dedicated ground stations which can receive data-link signals and process mission tapes. Eighteen TEREC Remote Terminals (TRTs) also support TEREC operations.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Work was completed on the engineering change proposal to modify the Commander's Tactical Terminal (CTT) being developed in the National Security Agency managed Tactical Cryptological Program. The result is the TEREC-capable CTT.

(2) FY 1987 Program: Efforts will develop a High Frequency (HF) radio encryption device for the TEREC data link system. Congress had cancelled follow-on TRT procurement in FY 1983 (requirement for 124 terminals); FY 1985 and FY 1986 funds (originally scheduled to fund the HF encryption for TEREC) were redirected to fund the engineering change proposal for the TEREC-capable CTT. [ ] While the ultrahigh frequency (UHF) radio link was encrypted during the original Class V modification program, there were no suitable encryption devices available for the HF link. [ ]

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The HF encryption design and fabrication will finish. Dollar figures relate to completion of the FY 1987 work based on Category II, Mature estimates.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The testing for the encryption devices for the RF-4, the TRT, and the TEREC-capable CTT will be completed. Cost estimates are Category IV, Planning.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not Applicable.

Program Element: 64710F
DOD Mission Area: 327 - TIARA for Tactical Air Warfare

Title: Reconnaissance Equipment
Budget Activity: 4 - Tactical Programs

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64715F
DOD Mission Area: 205 - Physical Security Systems

Title: DOD Physical Security Equipment-Exterior
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		13,301	16,536	11,332	5,148	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program supports the full-scale development of the Department of Defense Base and Installation Security System, a standardized set of components, interfaces, and methodology for creation of exterior physical security systems, by accomplishing full-scale development tasks in three functional areas: detection, command and control and imaging. A Department of Defense need exists for a family of standardized modular equipment which can be integrated into system configurations to provide a level of security in consonance with the deployment mode, threat level and sensitivity of the asset being protected. The resulting security equipment increases the capability of the security forces to detect and intercept terrorists and permits increased mobility of the forces for better utilization of existing manpower.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	15,332	18,511	11,758	N/A	Continuing	N/A
Other Procurement	33,380	0	11,883	N/A	Continuing	N/A

EXPLANATION: FY 1987 estimate reflects approximately $2 million less then shown in FY 1987 Descriptive Summary. Reductions reflect $1 million less appropriated by Congress than requested and $1 million reduction imposed by the Air Force for fuels and consultant adjustments. Reductions will delay completion of the Radar Airborne Intrusion Detection Program by one year.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
Other Procurement (27589F)						
Funds	33,380	0	8,288	8,404	Continuing	N/A
(Spares funds not included)						
Quantities	Not Applicable					

EXPLANATION: FY 1987 Other Procurement funds will delay by one year providing improved security systems for three USAFE bases.

5. (U) RELATED ACTIVITIES: Advanced development tasks including equipment prototypes, development of technology

base, and development testing are accomplished under Program Element 63714F, Department of Defense Physical Security Equipment-Exterior (Advanced Development). Procurement of physical security equipment is accomplished using Other Procurement-Air Force funding under Program Element 27589F, Air Force Physical Security Systems. The Base and Installation Security System equipment will be designed for interoperability with the Army interior security system (facility intrusion detection system) and the Army tactical sensor system (remotely monitored battlefied sensor system). Management oversight of the physical security equipment program is provided by the Department of Defense Physical Security Equipment Action Group with the Chairperson residing in the Office of the Under Secretary of Defense for Research and Engineering.

6. (U) WORK PERFORMED BY: This program is managed by the Physical Security Systems Directorate, Electronic Systems Division, Hanscom AFB MA. Department of Defense agencies performing development tasks are: Rome Air Development Center, Griffiss AFB NY; Army Mobility Equipment Research and Development Command and Army Night Vision Laboratory, Fort Belvoir, VA; Army Waterways Experimental Station, Vicksburg, MS; Naval Ocean Systems Center, San Diego, CA; and the Naval Coastal Systems Center, Panama City, FL. In addition to these Defense agencies, the Department of Energy/Sandia National Laboratory, Albuquerque, NM performs development tasks, and Analytical Systems Engineering Corporation assists with systems engineering support and integration tasks. Contractors presently developing security systems under this effort include E-Systems, Fairfax, VA; Computing Devices Company, Ottawa, Canada; Magnavox Electronics Systems Company, Ft Wayne, IN; Teledyne Controls Corporation, Los Angeles, CA; Sanders Association, Nashua, NH, and ISC Corporation, Lancaster, PA.

7. (U) PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 64715F, DOD Physical Security Equipment-Exterior

A. (U) Project Description: This program responds to Secretary of Defense direction contained in Department of Defense Directive 3224.3, 1 December 1976, which designates the Air Force as executive agency for the development of standardized exterior physical security equipment and systems for the protection of bases and installations. This program will provide pre-production equipment and subsystems, thorough test and evaluation, and production specifications for the Base and Installation Security System equipment for the four Services. The engineering development tasks consist of optimization of the overall system configuration through conduct of component, subsystem, and system testing, and preparation of production specifications. The total Base and Installation Security System objectives are to provide a capability for high level security, against all threat levels, for resources in the three deployment modes: permanent, semi-permanent and mobile. Facilities and developments of other Services, government agencies, and commercial industries will be used to the maximum to insure that duplication of effort is avoided.

B. (U) Program Accomplishments and Future Efforts:

Program Element: 64715F
DOD Mission Area: 205 - Physical Security Systems

Title: DOD Physical Security Equipment-Exterior
Budget Activity: 4 - Tactical Programs

(1) (U) FY 1986 Accomplishments: Security systems to protect open aircraft shelters and closed aircraft shelters completed full-scale development and are being deployed. The permanent individual resource protection sensor completed development and testing and is being deployed. Demonstration projects to improve waterside security at Naval shipyards and submarine bases were accomplished. Full scale development of the Mobile Individual Resource Protection Sensor, the Long Ported Coaxial Cable Sensor, and the Magnetic Line Intrusion Sensor Signal Processor were completed. Development of the Scope Shield Security Police Communication System was continued. Engineering development of the Foliage Penetration (FOLPEN) radar, for use in protecting assets that are employed in a dispersed mode, was initiated.

(2) (U) FY 1987 Program: The program provided for continued full-scale development of a number of sensor efforts. Development of video storage system continued. The video storage system is designed to store television images of intrusion attempts when more than one attempt is made. In addition to these efforts, engineering development for the Radar Airborne Intrusion Detection System (RAIDS) for use in protection against aerial threats, was initiated. The development of the Scope Shield Communication System, to provide a narrow band mobile secure voice communication capability, also continued in FY 1987. The tactical sensor program, which will develop and integrate sensors for use along external perimeters in high threat locations was initiated. The sensors would be employed along avenues of most likely approach of a hostile terrorist group attempting to penetrate a protected area.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Full-scale development of the Foliage Penetration Radar and the RAIDS will continue through FY 1988. In addition to these efforts, the tactical sensor program will be continued. The Category III, budgetary, cost estimate is based on inputs from various government agencies performing these development efforts, and was updated in September 1986.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Full-scale development of the RAIDS and the Tactical Sensor program will continue through FY 1989. The Category III, budgetary, cost estimate is based on inputs from various government agencies performing these development efforts and was updated in September 1986.

(5) (U) Program to Completion: This program will provide a family of modular electronic equipment, capable of being integrated in various system configurations to meet Department of Defense and Service requirements for physical security. As requirements for exterior physical security are validated, development tasks will be assigned to the Air Force by the Under Secretary of Defense for Research and Engineering to satisfy the requirement. This is a continuing program.

C. (U) Major Milestones:

	Milestones	Dates
(1) (U)	Foliage Penetration (FOLPEN) Radar Contract Award	October 1985
(2) (U)	Scope Shield Contract Award	March 1986
(3) (U)	Radar Airborne Intrusion Detection System (RAIDS) Contract Award *(Sep 86)	February 1987
(4) (U)	FOLPEN Development Completion	October 1988

(5) (U) RAIDS Development Completion July 1989

*Date presented in FY 1987 Descriptive Summary

(U) Explanation of Milestone Changes

(3) (U) RAIDS contract award slipped to consolidate all DOD requirements

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64724F
DOD Mission Area: 372-Escort, Stand-off and Counter Command, Control and Communications

Title: Tactical C^3 Countermeasures
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		26,112	19,043	12,761	8,915	Continuing	N/A
2462	COMPASS CALL	15,093	19,043	12,761	8,915	Continuing	N/A
2927	Pave Tiger*	11,019	0	0	0	0	37,600

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: To accomplish close air support, interdiction, and counter air missions, the Tactical Air Forces (TAF) require a command, control, and communications (C^3) countermeasures capability. Currently, the EC-130H stand-off jamming aircraft provides the capability to disrupt elements of the enemy defensive command, control and communications networks. With this capability, the TAF can isolate selected enemy units from their command and control to prevent these units from receiving target assignments and enemy aircraft from receiving control vectors. This program element is required to support pre-planned improvements to the baseline EC-130H jamming system to keep it current through the 1990's.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	29,660	24,636	16,363	N/A	Continuing	N/A
Aircraft Procurement	11,916	13,416	17,812	N/A	Continuing	N/A

EXPLANATION: (U) RDT&E: Congress reduced the FY 1987 Air Force request by $5.593 million. The Air Force reduced the FY 1988 estimate by $3.602 million to rephase the program and support higher priority requirements. Procurement: Funds were adjusted to align with reduced development efforts.

Program Element: 64724F
DOD Mission Area: 372 - Escort, Stand-off and Counter Command, Control and Communications

Title: Tactical C^3 Countermeasures
Budget Activity: #4 - Tactical Programs

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Aircraft Procurement*						
Funds	11,916	14,784	7,818	5,625	Continuing	N/A
Quantities (Includes various items)						

*Includes modifications and initial modification spares funding in PE 27253F, COMPASS CALL, associated with development efforts.

5. (U) RELATED ACTIVITIES: The Air Force production manager (Air Force Logistics Command) and development manager (Air Force Systems Command) for the EC-130H (Project 2462) operate with a joint agreement for interface and configuration control to ensure that new equipment can be incorporated into operational use. This program will build upon technology demonstrated in PE 63743F, Electronic Combat Technology, and PE 63749F, C^3 Countermeasures Advance Systems. This program provides engineering development for PE 27253F, COMPASS CALL.

6. (U) WORK PERFORMED BY: Aeronautical Systems Division, Wright-Patterson AFB, OH, manages the program to develop improvements to the EC-130H; Air Force Logistics Command, Wright-Patterson AFB, OH, manages the EC-130H modification program. The primary Compass Call contractors performing work for this effort include: Lockheed Aircraft Services, Ontario, CA (Project 2462); Sanders Associates, Nashua, NH (Project 2462); and Magnavox, Fort Wayne, IN (Project 2462).

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2462, COMPASS CALL.

A. Project Description: In FY 1979, the Air Force directed an EC-130H stand-off jamming platform to be integrated into a defense-wide command, control, and communications (C^3) jamming capability. The airborne capability will complement both present and future ground and sea-based systems to provide the theater commander with a coordinated jamming capability. The EC-130H stand-off jamming platform initially used readily available equipment to provide a near-term baseline capability. Meanwhile, the portions of the C^3 countermeasures package that needed development proceeded in this project. This project provides engineering development of jammers to counter or disrupt[ ] within the enemy C^3 network. This project makes major improvements to the initial EC-130H installed equipment to increase radiated power and simultaneously jam multiple threats. These preplanned improvements are necessary to correct known deficiencies in the baseline aircraft and to keep the EC-130H

Program Element: 64724F
DOD Mission Area: 372 - Escort, Stand-off and Counter Command, Control and Communications

Title: Tactical C^3 Countermeasures
Budget Activity: 4 - Tactical Programs

current into the 1990s. All improvements to the aircraft will also be made to the mission simulator to provide realistic mission-aircrew training.

B. (U) Program Accomplishments and Future Efforts:

(1) FY 1986 Accomplishments: Enhancements to the system will enable Compass Call to target to air resources. Studies and testing to determine jamming power and reliability improvements will conclude. Signal location updates will conclude while production and inclusion of this capability into the mission support facility will be inititiated. Software improvements to the baseline system were initiated to improve system efficiency.

(2) FY 1987 Program: Signal location production will continue and incorporation of this capability into the mission simulator will conclude. Developments for jamming power and reliability improvements will be initiated. Improved intercept and jamming development efforts to counter an will be investigated.

(3) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Pre-planned jamming power/relibility improvements and development efforts to counter an will continue. These activities will largely be supported through major software updates and antenna development. Since the late 1970's when COMPASS CALL was developed using off-the shelf equipment and technology, the EC-130H has demonstrated its utility in various exercises as an important and viable countermeasure to command and control systems. Ongoing pre-planned development efforts are a direct result of the development and procurement strategy that fielded this C^3CM capability and the threat that has emerged since the inception of the COMPASS CALL program. Development efforts for require special access. The cost estimates are Category III based primarily on current contract and the Air Force Systems Command Program Office experience with current, similar development programs and are as of August 1986.

(4) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Reliability and jamming power activities initiated in FY 1986 and FY 1987 respectively will continue. Antenna and power amplifier developments to support this effort will conclude. Integration of this hardware will continue. Efforts to develop countermeasures against systems employing will be initiated. Also, development for a capability will commence. The cost estimates are Category III based primarily on current contract and the Air Force Systems Command Program Office experience with current, similar development programs and are as of August 1986.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64725F
DOD Mission Area: 344 - Tactical Command and Control

Title: Combat Identification Systems
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	9,369	8,908	44,930	127,599	Continuing	N/A
2597	Noncooperative Identification Subsystems*	3,369	1,167	0	0	Continuing	N/A
2598	Mark XV USAF Unique Development **	3,000	3,541	3,000	26,075	Continuing	N/A
2751	Indirect Identification Subsystem	3,000	4,200	8,430	9,624	Continuing	N/A
3592	Mark XV Tri-Service Core Development ***	0	0	33,500	91,900	Continuing	N/A

* FY 1988-1992 funding for Project 2597 transferred to PE 63742F.
** Project 2598 previously named Cooperative Identification Systems.
*** Project 3592 added to identify Mark XV Tri-Service Core Development funding.

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The purpose of this program element is to accomplish engineering development of systems that will provide reliable in all-weather and hostile electromagnetic countermeasures environments. This program is necessary because the of the projected threat demands that we which is a prerequisite for such engagements.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989
RDT&E	12,829	12,012	29,494	N/A

EXPLANATION: (U) FY 1987 reduction reflects Congressional action. $15.4 million increase in FY 1988 reflects transfer of Army and Navy Mark XV IFF Core Development funding to the Air Force.

4. (U) OTHER APPROPRIATION FUNDS: Not applicable

Program Element: 64725F
DOD Mission Area: 344 - Tactical Command and Control

Title: Combat Identification Systems
Budget Activity: 4 - Tactical Programs

5. (U) RELATED ACTIVITIES: Work accomplished under this program element is part of an integrated Tri-Service effort to improve United States identification capabilities worldwide. Related activities include: Program Element (PE) 63790F, NATO Cooperative RDT&E; PE 63790A, NATO Cooperative RDT&E; PE 63790N, NATO Cooperative RDT&E; PE 63267N, NATO Future Identification System; PE 63515N, Advanced Identification Techniques; PE 63706A, Identification Friend or Foe (IFF) Developments; PE 64211N, Air Traffic Control Radar Beacon System/Mark XII; and PE 64709A, IFF Equipment. Coordination and integration of the various activities under these program elements are accomplished through the Air Force led Tri-Service, Combat Identification System Program.

6. (U) WORK PERFORMED BY: The Mark XV IFF program is managed by the Tri-Service, Combat Identification System Program Office (CISPO) at the Aeronautical Systems Division, Air Force Systems Command, Wright-Patterson AFB, OH. The Indirect Subsystem program is managed by the Combat Identification System - Indirect Subsystem program office (CIS-ISS) at Electronic Systems Division, Air Force Systems Command, Henscom Air Force Base, MA. Support is also provided by the MITRE Corporation, Bedford, MA and the Electromagnetic Compatibility Analysis Center, Annapolis, MD. Additionally, the following contractors are currently engaged in work under this program: Allied-Bendix Communications Division, Baltimore, MD (project 2598); and Texas Instruments, Dallas, TX (project 2598).

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

Project: 2751 Indirect Identification Subsystem. A reliable means of weapon systems at distances that is needed to limit our forces' exposure to while still taking advantage of our own No such reliable means for providing this identification exists today. In fact, because of associated with all known identification techniques, the required can only be provided through the effective use This project involves the development and demonstration of techniques to use

Initial demonstration efforts used and displays coupled with limited data to validate the feasibility of using this type of data in improving the overall identification process. In October 1985, the European demonstration concluded successfully. This demonstration showed the value of automating the which allowed improved This capability will allow commanders to optimize and enhance survivability of aircrews through timely warnings. In FY 1986, the program office analyzed the demonstration results, and prepared for full-scale development (FSD) of the system. In addition, the program evaluated technologies/programs of all three Services for applicability to ISS FSD requirements. This review concluded in September 1986. At the approved funding level, from FY 1987 on, the program will define the results from the demonstrations, and incorporate Tactical Air Command's (TAC) stated ISS requirements for the command and control (C^2) network into the overall program strategy for FSD. In addition, the program will continue engineering analysis and in late FY 1988 will begin a low level development effort focused on incorporating the ISS processing algorithm into the MCE by the early 1990's. The start of hardware development for a will be delayed until 1990.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2598 Mark XV USAF Unique Development.

A. (U) Project Description: This project funds the Air Force Mark XV IFF unique full scale development (FSD) effort under the Combat Identification System (CIS) Program, to evolve comprehensive and balanced improvements to U.S. identification capabilities worldwide. For these improvements to have maximum effectiveness they must be interoperable with the identification capabilities of U.S. allies. To this end the United States is cooperating with the other NATO nations to reach agreement on the basic operating characteristics (e.g., signals-in-space) of future identification equipment. The work in this project addresses the development of a direct, cooperative identification system (i.e., use of cryptographically secure questions and answers), called the Mark XV, to replace the aging Mark XII system. The Mark XV is the U.S. component for the NATO Identification System's Direct Subsystem. The thrust of the effort is the design, testing, and integration of USAF unique engineering development for the Mark XV system. The efforts in this project support, and are supported by, parallel Tri-Service development efforts in Project 3592.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: This Program Element picks up the Mark XV Program in FY 1986 as preparations for FSD start. *Efforts in this year focus on the system engineering analysis* required to prepare the system specification for FSD as result of testing and NATO negotiations. NATO negotiations/efforts are focused on resolving the NATO waveform refinement process by early FY 1987. This project also funds preparations for FSD as initial development of the FSD specifications and request for proposal (RFP) are developed.

(2) (U) FY 1987 Program: Mark XV advanced development models (ADMs) will be delivered to the government in 1Q FY 1987. Laboratory and flight testing of these ADMs will commence in 2Q FY 1987 and continue into 3Q FY 1987. These tests will focus on performance of the Mark XV waveform and assist in the development of the FSD specification. NATO negotiations will be focused on the concluding the waveform refinement process and, in parallel, exploring opportunities for European industrial cooperation in full scale development (FSD). Release of the FSD RFP and evaluation of the proposals and selection of the FSD contractors will occur in FY 1987, and finish in time for Milestone II in March 1988.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The FY 1988 request supports the start of full scale development of the Air Force service unique program. These efforts support, and are supported by, parallel FSD efforts in the Tri-Servce/NATO core development program (Project 3592). USAF-unique development efforts will be focused on the design of Mark XV engineering design models (EDMs) with configurations unique to specific USAF weapon systems (e.g., E-3). In addition, Group A modification kit designs for integrating the Tri-Service/NATO Mark XV interrogators and/or transponders into compatible platforms will commence.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The FY 1989 request funds the second year of full scale development for Air Force service unique efforts. USAF-unique development efforts will focus on the design and fabrication of Mark XV engineering design models (EDMs) and Group A modification kit designs for integrating

the Tri-Service/NATO Mark XV interrogators and/or transponders into compatible platforms will continue. Preliminary Design Review will occur in the 1st Quarter and the Critical Design Review will occur in the 4th Quarter.

(5) (U) Program to Completion: Design, fabrication, and testing of USAF-unique Mark XV interrogators and transponders, and Group A modification kits for the Tri-Service/NATO standard configurations of interrogators and transponders will conclude. Production and retrofit will commence in the early 1990's.

C. (U) Major Milestones:

		Milestones	Dates
(1)	(U)	Milestone II	March 1988
(2)	(U)	Long Lead Procurement Starts	2nd Quarter FY 1991
(3)	(U)	Milestone IIIA	3rd Quarter FY 1992
(4)	(U)	Low Rate Production Deliveries	4th Quarter FY 1992
(5)	(U)	Milestone IIIB	3rd Quarter FY 1993
(6)	(U)	Full Rate Production Starts	1st Quarter FY 1995
(7)	(U)	Full Rate Production Deliveries	1st Quarter FY 1995

9. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3592 Mark XV Tri-Service Core Development.

A. (U) Project Description: This project funds the Tri-Service (Air Force led) FSD core effort under the Combat Identification System (CIS) Program, to evolve comprehensive and balanced improvements to U.S. identification capabilities worldwide. For these improvements to have maximum effectiveness they must be interoperable with the identification capabilities of U.S. allies. To this end the United States is cooperating with the other NATO nations to reach agreement on the basic operating characteristics (e.g., signals-in-space) of future identification equipment. The work in this project addresses the development of a direct, cooperative identification sysem (i.e., use of cryptographically secure questions and answers), called the Mark XV, to replace the aging Mark XII system. The Mark XV is the U.S. candidate for the NATO Identification System's Direct Subsystem. The thrust of the effort is the design and testing of engineering development models of the Mark XV system. The results of such tests will support the basis for validating the interoperability agreement with NATO. The efforts in this project support, and are supported by, parallel USAF unique development efforts in Project 2598.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Not Applicable.

(2) (U) FY 1987 Program: Not Applicable.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The FY 1988 request supports the start of full scale development (FSD) of the Tri-Service/NATO core program. Milestone II is planned for March 1988. FSD contract award will occur in the 3rd Quarter. The FSD program is currently planned to include NATO industrial participation with U.S. contractors as lead developers. The FSD core program will initiate the designs for five Mark XV systems (two standard transponders, airborne interrogator, ship interrogator, and a long range ground interrogator) as a family of common DOD configurations.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The FY 1989 request funds the second year of full scale development of the Tri-Service Core/NATO Mark XV IFF program. Core development efforts will focus on the design and fabrication of Mark XV engineering design models (EDMs). Design of Group A modification kit for integrating the Tri-Service/NATO Mark XV interrogators and/or transponders into designated core platforms will continue. Preliminary Design Review will occur in the 1st Quarter and the Critical Design Review will occur in the 4th Quarter.

(5) (U) Program to Completion: Design, fabrication, and testing of the Tri-Service/NATO core Mark XV interrogators and transponders, and Group A modification kits for these interrogators and transponders will conclude. Integration of Mark XV interrogators and transponders into the designated core platforms will begin in 4th Quarter FY 1990. Tri-Service Core Development Test and Evaluation (DT&E) will commence in 3rd Quarter FY 1991. Tri-Service Core Initial Operational Test and Evaluation (IOT&E) will commence in late 4th Quarter FY 1991 and continue through 1st Quarter Fy 1993. Low rate initial production and retrofit will commence in early FY 1993.

C. (U) Major Milestones:

Milestones	Dates
(1) (U) Milestone II	March 1988
(2) (U) Long Lead Procurement Starts	2nd Quarter FY 1991
(3) (U) Milestone IIIA	3rd Quarter FY 1992
(4) (U) Low Rate Production Deliveries	4th Quarter FY 1992
(5) (U) Milestone IIIB	3rd Quarter FY 1993
(6) (U) Full Rate Production Starts	1st Quarter FY 1995
(7) (U) Full Rate Production Deliveries	1st Quarter FY 1995

10. (U) COOPERATIVE AGREEMENTS: The Tri-Service (Air Force led) Mark XV IFF program is the United States contribution to the NATO Identification System, Question and Answer Component (NIS Q+A) research and development efforts focused on interoperable identification capability within the NATO alliance. The United States cooperated with the other NATO nations (United Kingdom, France, Federal Republic of Germany, and Italy) and reached an agreement, in December 1986, on the basic operating characteristics (e.g., signals-in-space) of this future identification system. The five nations are currently cooperating through the exchange of technical information and limited interoperability testing necessary to reach a waveform agreement in FY 1987. In addition, the United States Governement is exploring the opportunities for

cooperative development during the full scale development phase of the US Mark XV IFF program. In addition to the funding within project 2598, the Mark XV IFF program received $21.7 million in FY 1986 ($8.7 million from 63790A, $8.5 million from 63790F, $4.5 million from 63790N), and $5.8 million in FY 1987 ($4.5 million from 63790A, and $1.3 million from 63790N) as a designated Tri-Service NATO Cooperative RDT&E program. Contractors involved are the current Mark XV development and support contractors.

Budget Activity: 4. Tactical Programs
Program Element: 64725F, Mark XV

Test and Evaluation Data

1. (U) Development Test and Evaluation (DT&E): The Aeronautical Systems Division (ASD) of the Air Force Systems Command is the program manager for this tri-service program. DT&E is currently projected to be conducted in two phases (DT&E-I and II) with the first phase to commence in early FY 1987. DT&E-I will consist of Advanced Development Model (ADM) equipment tested under laboratory conditions in the Demonstration/Validation (D/V) contractor's facilities with additional D/V testing to be conducted using Air Force ASD/4950th Test Wing aircraft which are being modified for Mark XV testing. The D/V phase includes form, fit, and function (F^3) analysis and demonstration to determine if the required technology is available to permit full scale development (FSD) within size, weight, and power constraints and to reduce risk entering FSD. Flight testing conducted during DT&E-I will be used to verify the data base gathered during laboratory testing and to perform tests unique to flight testing using simulated threat and signal densities. This testing will be conducted in the Wright-Patterson AFB, Ohio area using 4950th modified C-141 and C-135 aircraft, ground station equipment consisting of an interrogator configuration similar to that in the C-135 test aircraft, an Army Hawk interrogator system, and at the Naval Air Test Center (Patuxent River) for overwater multipath and Navy-unique testing. Some NATO interoperability testing will also occur in early FY88 as part of DT&E-I.

(U) DT&E-II will be conducted as part of the FSD effort with the 4950th Test Wing as the responsible test organization. Emphasis during this phase will be placed on Mark XV reliability under simulated combat environments, system interoperability with NATO Mark XV equivalent systems, demonstration of FSD contract specified performance parameters, and estimation of maintainability and supportability. Specific tests scheduled to occur during DT&E-II include laboratory testing, DT&E-II Flight Test which includes C-135 and C-141 aircraft, and Core DT&E-II Testing on operational weapon system platforms.

2. (U) Operational Test and Evaluation (OT&E): Air Force Operational Test and Evaluation Center (AFOTEC) has been directed to conduct the Mark XV IFF tri-service OT&E program supported by the Army's Operational Test and Evaluation Agency (OTEA) and the Navy's Operational Test and Evaluation Force (OPTEVFOR). The multiservice IOT&E of the Mark XV will be conducted during both the D/V (IOT&E-I) and the Full-Scale Development (IOT&E-II) portions of the program.

(U) IOT&E(I). This phase of IOT&E will provide an early evaluationn of the operational utility of the Mark XV design approach. Data from interviews, documentation reviews, and questionnaires will be used in the evaluation. D/V (DT&E-I) flight tests of the ADM hardware will be observed. Testbeds will include an AF C-135, two C-141s, and a ground interrogation capable system. Test sites will be Wright-Patterson AFB, Ohio, and Patuxent River Naval Air Station. This phase is scheduled for February through May 1987. AFOTEC will observe this testing to help define, and or reduce the decision risk at JRMB II, identify potential operational deficiencies early, and identify opportunities for improvement before the FSD phase.

Budget Activity: 4. Tactical Programs
Program Element: 64725F, Mark XV

(U) IOT&E(II). The IOT&E(II) of the Mark XV will start during the second quarter of FY 89 as a combined IOT&E/DT&E test program. The purpose is to provide an initial operational effectiveness and suitability assessment in representative operational environments. The goal is to reduce the decision risk at JRMB III, identify potential operational deficiencies, and identify opportunities for further improvement. During IOT&E(II), production representative equipment will be integrated and evaluated on selected platforms that represent the most stressing environments expected. The selected platforms are the F-15 and F-18 to represent airborne interrogators and transponders, the Army's Hawk system to represent ground interrogators, the UH-60 to represent rotary wing aircraft, and an AEGIS cruiser and Spruance Destroyer to represent the shipboard environment. Test events will be structured to assess operational effectiveness and suitability in the air-to-air, surface-to-air, surface-to-surface areas. A computer simulation will be used to assess Mark XV capability in an environment of multiple concurrent interrogations and transponder responses, airborne and ground jammers will attempt to simulate an ECM environment and an exploitive environment. Mark XV availablity, reliability, maintainability, and logistics supportability will also be assessed. Testing will be conducted using Air Force, Army, and Navy "hands-on" maintenance to the maximum extent feasible. Testing in weapon platforms, other than those identified above, will be service unique and conducted during follow-on test and evaluation (FOT&E). Test sites identified to date are: Nellis AFB, Nevada; Patuxent River NAS, Maryland; and Wright-Patterson AFB, Ohio. This phase is scheduled for January 1990 to June 1991. Following testing of the Mark XV in CONUS, additional testing will be conducted that will involve US-built Mark XV IFF equipment and interoperable NATO equipment on NATO platforms. The NATO platforms are not yet specified. Test sites have not been selected but most likely will be located in West Germany. This test segment may be conducted in the early FY 91 timeframe.

3. (U) System Characteristics : Characteristics for the Mark XV will be definitized during the D/V phase, and documented in the development specification finalized prior to FSD. The primary objective of the program is to develop a NATO interoperable, jam resistant, and secure cooperative system to identify friendly aircraft and ships. Specific thresholds for the Mark XV system will be identified before the JRMB II review.

Characteristic	Objective (Goal)	Demonstrated	Remarks
Operational Range	Platform Dependent For example (Representative goals): Fighter Aircraft (e.g., F-15/F-14) [ ] Airborne Early Warning (e.g., E-3A) [ ]	To be determined	Will be equal to or greater than primary weapon system sensor range

Budget Activity: 4. Tactical Programs
Program Element: 64725F, Mark XV

Characteristic	Objective (Goal)	Demonstrated	Remarks
	Surveillance Radar (e.g., TPS-43) [ ]		
	High Altitude Missile Air Defense (HIMAD) (e.g., Patriot) [ ]		
System Capacity	[ ] interrogations/second	To be determined	Based on most dense European environment
Anti-Jam Performance	[ ] jamming/signal margin	To be determined	Based on broad band noise jamming
Identification Reliabilities			
P (Friend Acceptance/Friend)	[ ]	To be determined	Probability of accepting a friend given he is a friend
P (Friend Rejection/Friend)	[ ]	To be determined	Probability of rejecting a friend given he is a friend
P (Enemy Acceptance/Enemy)	[ ]	To be determined	Probability of accepting an enemy given he is an enemy
(U) Reliability/Maintainability/Availability			
Mean Time Between Failure	1000 hrs	To be determined	System specified on demonstration in laboratory
Mean Time To Repair	30 minutes	To be determined	On site maintenance

Budget Activity: 4. Tactical Programs
Program Element: 64725F, Mark XV

4. (U) Current Test and Evaluation (T&E):

T&E Activity (Past 12 Months)

Event	Planned Activity	Actual Date	Remarks
COMSEC Integration/ Checkout		Mar-Sep 86	Contractor has verified system Interfaces
Qualification/Acceptance Testing (ADMs)	Jun-Aug 86	Sep 86 - Feb 87	Testing is in progress

T&E Activity (Next 12 Months)

Event	Planned Date	Remarks
ADM Integration into Testing Aircraft	Jan-Feb 87	Subcontracted to ESI, Inc. Waco, TX
Laboratory Testing	Dec 86 - Mar 87	Contractor conducted - Government approved test plan
Flight Testing U. S. Prime Contractors	Feb-May 87	4950TW NATC Conducted at WPAFB OH. NAS PAtuxent River, MD
Interoperability Testing	Mar 87	Two week test - Government conducted
Plug Compatability Testing Demonstration	Mar 87	Navy/Army conducted, to occur at NESEA - St Inigoes, MD
NATO Interoperability Testing	Early FY 88	NATO Refinements Working Group is planning and organization
Test and Evaluation Master Plan (TEMP)	Sep 87	22 Jul 86 TEMP in effect. TEMP completion will show increased emphasis on FSD testing

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64733F
DOD Mission Area: 224 - Defense Suppression

Title: Surface Defense Suppression
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost*
TOTAL FOR PROGRAM ELEMENT		27,496	27,550	40,775	28,137	6,053	372,491
3006	Standoff Attack GBU-15 P^3I	27,496	27,550	40,775	28,137	6,053	159,831

*Includes projects completed prior to FY 1986.

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element (PE) develops and tests the AGM-130A air-to-ground weapon system. The AGM-130A is a Preplanned Product Improvement (P^3I) of the GBU-15 previously developed under this PE. While the lower cost GBU-15 is effective against targets protected by terminal defenses, the AGM-130 is designed to attack high value targets which have extended terminal area defenses including extensive electronic countermeasures. The AGM-130A is the only Air Force general purpose medium range standoff attack weapon. It has a 2,000 pound warhead and the television (TV) or imaging infrared (IIR) seeker of the GBU-15 coupled with a rocket motor for extended range and an improved data link for AGM-130 control in extensive electronic countermeasure environments. The AGM-130A will have the capability to attack from standoff range, well outside terminal area defenses, in day and night and in an electronic countermeasures environment. This PE covers the development of the basic AGM-130A, an improved data link and advanced support equipment. It also covers the certification of AGM-130A for carriage and delivery from the F-4E, F-111F, and F-15E aircraft.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	29,235	44,119	34,182	N/A	29,341	357,085
Missile Procurement (AGM-130A)	19,000	27,345	56,697	N/A	1,672,999	1,776,041
Other procurement (GBU-15)	85,000	138,905	0	N/A	0	582,701

EXPLANATION: RDT&E decreased in FY 1986 principally due to a $1.652 million Gramm-Rudman-Hollings (GRH) reduction and a $.216 million inflation reduction. FY 1987 RDT&E reduction is due to a $15.619 million cut in congressional appropriations and a $.950 million general reduction directed by Congress. FY 1988 RDT&E increased to cover development efforts not funded in FY 1987.
- Missile procurement decreased in FY 1986 due to a $1.051 million GRH cut, a $3.137 million inflation reduction and a $.538 million reprogramming for civilian pay. FY 1987 reduction is due to a $11.123 million cut in congressional

appropriations and a $.539 million general reduction directed by Congress. FY 1988 decrease is due to delaying the procurement of the Advanced Support Equipment ($14.6 million) and tooling/test equipment for the Improved Data Link ($6.6 million). Since only TV versions will be bought in 1988, the unit cost decreased.
- Other procurement decreased in FY 1986 due to a $4.165 million Gramm-Rudman-Hollings (GRH) cut. FY 1987 reduction is due to a $28.905 million cut in congressional appropriations and a $3.026 million general reduction directed by Congress. FY 1987 funds also include $.184 million for initial spares.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost*
Aircraft Procurement (PE 27165F)						
Funds	0	0	0	26,900	148,561	175,461
Quantities (data link pods)	0	0	0	91	562	653
Missile Procurement (PE 27165F)						
Funds	14,274	15,683	44,761	93,865	1,423,917	1,592,500
Quantities (AGM-130A)	0	40	121	235	5192	5588
Other Procurement (PE 28030F)						
Funds	80,835	107,158	0	0	0	
Quantities (GBU-15)	495	550	0	0	0	

*Includes projects completed prior to FY 1986.

5. (U) RELATED ACTIVITIES: A Part Task Trainer (PTT) simulator for the AGM-130A is being developed under Program Element 64227F, Flight Simulator Development.

6. (U) WORK PERFORMED BY: Program management is provided by Headquarters, Air Force Systems Command (AFSC), Andrews AFB, MD and Armament Division (AD), Eglin AFB, FL. Major contractors are Rockwell International (prime contractor), Duluth, GA and Hughes Aircraft Co. (current data link contractor), Culver City/Canoga Park, CA and Hughes Georgia Inc (HGI), LaGrange, GA (IIR seeker contractor). Harris/Magnavox team, Melbourne, FL is the contractor for the improved data link. Contractors for the advanced support equipment program and the F-15E integration efforts have not yet been identified.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3006, Standoff Attack GBU-15 Preplanned Product Improvement (P^3I):

A. (U) Project Description: Develops and tests the AGM-130A (a powered GBU-15). The guidance system for the AGM-130 will remain GBU-15's television (TV) and imaging infrared (IIR) seeker with a controlling data link. The AGM-130A utilizes a 2000 lb unitary warhead (MK-84). An upgrade to the current GBU-15 data link will be developed to ensure total system performance in current and projected threat environments. Improved support equipment will be developed to provide increased efficiency and mobility and to account for weapon system operational differences between the AGM-130 and GBU-15. The weapon system will also be integrated for carriage, release and control off the F-4E, F-111F and F-15E aircraft.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: AGM-130A full scale development (FSD), initiated on 7 September 1984, was continued. The critical design review was completed in May 1986. Motor preflight readiness testing was completed in August 1986. AGM-130A Development Test and Evaluation/Initial Operational Test and Evaluation (DT&E/IOT&E) continued. Integration of the AGM-130 on the F-4E and F-111F aircraft continued.

(2) (U) FY 1987 Program: Continue AGM-130A DT&E/IOT&E, system integration and preparation for AGM-130A production. Complete motor qualification. Continue integration of the AGM-130 on the F-4E and F-111F. Begin full scale development of the improved data link. The data link is key to successful weapon system operation and high terminal accuracy. The improved data link will include advanced anti-jam techniques to ensure weapon system man-in-the-loop operation is maintained to target impact. Operational compatibility with the current GBU-15 data link will be designed into the improved data link.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Complete AGM-130A DT&E/IOT&E with the TV seeker, system integration and preparation for AGM-130A production. Complete AGM-130A DT&E with the IIR seeker. Continue AGM-130A IOT&E with the IIR seeker. Continue development of the improved data link. Initiate integration of the AGM-130A onto the F-15E aircraft. This effort will qualify the AGM-130A on the F-15E for carriage, release and control. Initiate full scale development of advanced support equipment. The advanced support equipment design will provide faster weapon system assembly and checkout, improved support equipment reliability and maintainability, and greater support equipment mobility through smaller size and modular construction. Cost estimates are based on past GBU-15 development/production and are Category IV estimates.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Complete AGM-130A IOT&E with the IIR seeker. Continue development and initiate Development Test and Evaluation/Initial Operational Test and Evaluation (DT&E/IOT&E) of the Improved Data Link (IDL). Complete construction/fabrication of flight test hardware for the IDL. Continue the design and development of the advanced support equipment. Continue integration of the AGM-130A onto the F-15E aircraft. Enviromental impacts (i.e., vibration and loads for the F-15E carrisge) on the weapon as well as physical and electrical compatibility will be determined. This effort includes a flight test program. Cost estimates are based on past GBU-15 development/production and are category IV estimates.

(5) (U) Program to Completion: Complete development and DT&E/IOT&E of improved data link and initiate full rate production. Complete development of the Advanced Support Equipment (ASE) and the AGM-130A integration on the F-15E aircraft.

C. (U) Major Milestones:

	Milestones		Dates
(1) (U)	AGM-130A FSD Start		September 1984
(2) (U)	AGM-130A DT&E/IOT&E Start		September 1985
(3) (U)	AGM-130A Critical Design Review Complete	*(1st Quarter FY 1986)	May 1986
(4) (U)	Improved Data Link FSD Start	*(4th Quarter FY 1986)	1st Quarter FY 1987
(5) (U)	AGM-130A Low Rate Production Decision	*(3rd Quarter FY 1987)	3rd Quarter FY 1988
(6) (U)	Advanced Support Equipment FSD Start	*(2nd Quarter FY 1987)	1st Quarter FY 1988
(7) (U)	F-15E Integration Start	*(2nd Quarter FY 1987)	3rd Quarter FY 1988
(8) (U)	Improved Data Link Low Rate Production Award	*(4th Quarter FY 1988)	4th Quarter FY 1989
(9) (U)	Advanced Support Equipment Procurement	*(1st Quarter FY 1989)	4th Quarter FY 1990
(10) (U)	F-15E Integration Completion	*(4th Quarter FY 1989)	3rd Quarter FY 1990

* Date presented in FY 1987 Descriptive Summary.

(U) Explanation of Milestone Changes

(3) (U) AGM-130A critical design review delay due to rocket motor difficulty and inadequate data.
(4) (U) Delays in approval of the Improved Data Link acquisition plan delayed FSD start.
(5) (U) Delayed by development quality and design difficulties.
(6) (U) FY 1987 Congressional budget cut delayed the FSD start.
(7) (U) FY 1987 Congressional budget cut delayed the FSD start and required descoping of the program.
(8) (U) FY 1987 Descriptive Summary production start assumed that IDL FSD could be shortened to maintain the production start. Subsequent review showed this is not possible and production start was delayed.
(9) (U) FY 1987 Congressional budget cut delayed the FSD start and consequently procurement.
(10) (U) FY 1987 Congressional budget cuts delayed the FSD start and consequently completion.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

Budget Activity: 4. Tactical Programs
Program Element: #64733F, Surface Defense Suppression

Test and Evaluation Data

1. (U) Development Test and Evaluation (DT&E): The AGM-130 is a product improvement to the modular guided glide bomb, GBU-15. The AGM-130 consists of the basic GBU-15 with a propulsion system for increased standoff range and expanded mission capability. The AGM-130 Full Scale Development (FSD) program consists of developing an AGM-130/A with a MK-84 (2000 lb) unitary warhead. Because of the similarities with the GBU-15, the AGM-130 testing will be a combined Development Test and Evaluation (DT&E)/Initial Operational Test and Evaluation (IOT&E).

(U) The GBU-15 glide weapon consists of guidance, control and airfoil modules which are integrated with the MK-84 unitary warhead. Guidance is provided by either a television (TV) or imaging infrared (IIR) seeker with data link control. The GBU-15/TV is in production having successfully completed Follow-on Operational Test and Evaluation (FOT&E) on 17 November 1983 with 16 direct hits out of 18 launches. One hundred and eighteen F-4E and 106 F-111F effective sorties were flown in support of FOT&E. Five launches were conducted in the GBU-15/IIR DT&E program, all of which were off an F-4E aircraft. Three of the five launches were successful. Of the two misses, one weapon overflew the target as a result of an accumulation of events involving data link video breakup, tactics and seeker limitations. The second miss resulted from a weapon computer dump caused by aircraft power transients. This problem was corrected by initiating the weapon battery power earlier in the launch sequence. Thirty five F-4E and two F-111F effective captive flights were flown in support of DT&E.

(U) The development contractor for the GBU-15 and AGM-130 is Rockwell International Corp., Duluth, GA. Program management is provided by Headquarters, Air Force Systems Command, Andrews Air Force Base, MD, and its subordinate organization, Armament Division, Eglin Air Force Base, FL.

2. (U) Operational Test and Evaluation (OT&E): AGM-130 testing will be a combined DT&E/IOT&E with AFOTEC conducting the OT&E portion. Tests will be conducted at Eglin AFB using the ARN-101 F-4E aircraft and at McClellan AFB using the F-111 aircraft. China Lake Naval Weapons Center ranges will be used for the F-111F launches. The missions will be flown by TAC aircrews with TAC maintenance personnel maintaining the system. In addition, captive-carry missions will be flown in Europe by F-111F aircraft and crews from Lakenheath AB, UK. The AGM-130A IOT&E was scheduled to start in March 1986. Due to development problems, the program has been delayed and is now scheduled to begin in January 1987. Approximately 10 months will be required to complete IOT&E. Due to the problems with the data link control system encountered in the TV GBU-15 OT&E conducted by TAC, AFOTEC will not evaluate the data link during AGM-130A IOT&E. However, an improved data link (IDL) is presently under development and a separate OT&E will be conducted at a later date.

Budget Activity: 4. Tactical Programs
Program Element: #64733F, Surface Defense Supression

(U) The GBU-15 Imaging Infrared (IIR) version Initial Operational Test & Evaluation (IOT&E) was completed in February 1985. Results indicated potential operational utility, but did not support full-rate production. Low rate production was authorized in quantities sufficient for further OT&E during 1986-88. Testing would be a two-phase follow-on OT&E (FOT&E), the first phase, FOT&E(I), to be conducted by AFOTEC and the second, FOT&E(II), by TAC. Purpose of FOT&E(I) is to evaluate corrective modifications addressing problems identified during IOT&E. The AFOTEC FOT&E(I) is planned in two parts. Part 1 is a quick look at modifications to the IIR guidance module under controlled conditions. Part 2 will be a full OT&E conducted in 1987 with 20 low-rate production weapons.

3. System Characteristics:

Characteristics	Objective	Threshold	Demonstrated[1]
Maximum Mach			
Maximum Altitude (feet)			
Minimum Altitude (feet)			
Range (Nautical Mile) GBU-15			
AGM-130			
Accuracy (feet) (Circular Error Probable)			
Reliability (weapon hardware inflight)	.95	.90[3]	.95[4]

1 Demonstration of parameter maximum was not necessarily a test objective.
2 Data not specified in technical specifications.
3 Tactical Air Command goal for Initial Operational Test and Evaluation.
4 Demonstrated during Development Test & Evaluation/Initial Operational Test and Evaluation.
5 Demonstrated during Development Test and Evaluation program conducted by Air Force Systems Command.

737

Budget Activity: 4.Tactical Programs
Program Element: #64733F, Surface Defense Suppression

4. (U) Current Test and Evaluation (T&E):

T&E Activity (Past 12 Months)

Event	Planned Activity	Actual Date	Remarks
AGM-130/A Development Test & Evaluation Start	September 1985	Ongoing	Captive carry flight tests in progress
GBU-15/IIR FOT&E(I) Part 1	November 1985	January 1986	Test start delayed for availability of modified guidance modules

T&E Activity (Next 12 Months)

Event	Planned Date	Remarks
AGM-130/A IOT&E Start	January 1987	Test start planned for September 1986 on hold pending development and verification of manual tracking corrective modifications
GBU-15/IIR FOT&E(I) Part 2	January 1987	

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64737F
DOD Mission Area: 371 - Self-Protection

Title: Airborne Self-Protection Jammer (ASPJ)
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		8,534	11,933	21,545	8,047	Continuing	N/A
2712	ASPJ Common Development	5,515	2,349	8,976	5,004	Continuing	N/A
2719	F-16/ASPJ Development/Integration	3,019	9,584	12,569	3,043	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Airborne Self-Protection Jammer (ASPJ), designated the AN/ALQ-165, is a joint Air Force/Navy engineering development program for an internally-mounted Electronic Countermeasures (ECM) system. The Navy is the lead service. The ASPJ will provide self-protection and increase the probability of aircraft survivability when various tactical aircraft (F-16, F-14, F/A-18, A-6E, and AV-8B) are confronted by modern, diversified, radar-controlled weapon systems. Development of associated support equipment, advanced technology and aircraft integration are included in this program element. Major component, subsystem and system development will continue through full-scale development leading to a production decision. Engineering Development Model systems will undergo effectiveness, qualification and reliability testing.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	5,000	10,071	0	N/A	Continuing	N/A

EXPLANATION: FY 1986 increase was required after program delays. Increases in FY 1987 through completion is required to complete test and evaluation and to achieve product improvements for [ ] and increased capability.

4. (U) OTHER APPROPRIATION FUNDS: Not applicable.

Program Element: 64737F
DOD Mission Area: 371 - Self-Protection

Title: Airborne Self-Protection Jammer (ASPJ)
Budget Activity: 4 - Tactical Programs

5. RELATED ACTIVITIES: This program is structured as a joint Navy/Air Force effort with Navy funds provided under PE 64226N, Advanced Self-Protection Systems. The intent of this program is to attain 100 percent commonality of the Airborne Self-Protection Jammer (ASPJ) system design for internal application and to equally share the total Group B cost of engineering development between the two services. The Air Force and Navy joint development efforts were initiated during FY 1979. Air Force funds were provided under PE 64738F, Protective Systems, and PE 64739F, Tactical Protective Systems. In FY 1980 Air Force direction and funds for this effort were consolidated under PE 64737F, Airborne Self-Protection Jammer. The F-16 internal electronic countermeasures efforts are directly related to PE 27133F, F-16 Squadrons. A Memorandum of Agreement was signed by the Commander, Naval Air Systems Command, the Commander, Aeronautical Systems Division and the Commander, USAF Acquisition Logistics Division in July 1982 and remains the operative document covering the joint development program. The ASPJ Joint Program Office (JPO) is developing a [ ] capability for ASPJ for F-16 and Navy fighter aircraft application. This program is scheduled to start in FY 1988. The F-16 radar warning receiver program is being interfaced with the ALQ-165 to ensure compatibility.

6. (U) WORK PERFORMED BY: ASPJ development is managed by a joint Navy/Air Force Program Office at the Naval Air Systems Command, Washington, DC. The Navy is the lead service. The Air Force unique portion of this program, integration of the ASPJ into the F-16, is managed by the Air Force Systems Command, Aeronautical Systems Division, Wright-Patterson AFB, OH, with assistance from Air Force Logistics Command, Wright-Patterson AFB, OH. The ASPJ Phase I design effort was accomplished by two competitive contractor teams. One team was Northrop Corporation, Rolling Meadows, IL, and Sanders Associates, Nashua, NH. The second team was ITT, Nutley, NJ, and Westinghouse Corporation, Baltimore, MD. The ITT/Westinghouse team was selected during FY 1981 to proceed into Phase II (full scale development) to develop Engineering Development Models. Integration of ASPJ into the F-16 is being accomplished by General Dynamics, Ft Worth, TX.

7. (U) PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

Project: 2712, ASPJ Common Development. This project funds the Air Force share of the joint Navy/Air Force common development of the ASPJ (ALQ-165). This development is required to increase Air Force and Navy tactical aircraft survivability and provide an enhanced probability of mission success. ALQ-165 Research, Development, Test and Evaluation (RDT&E) is required to develop advanced Electronic Countermeasures (ECM) techniques for countering existing and projected threats|

| Twelve ASPJ Engineering Development Models (EDM) will be used for system effectiveness evaluations, reliability testing, qualification testing, Development Test and Evaluation (DT&E) and Initial Operational Test and Evaluation (IOT&E). In FY 86, the ASPJ completed DT&E at the Air Force Electronic Warfare Evaluation Simulator (AFEWES) and met all measures of effectiveness (MOE) in the AFEWES multiple threat environment. Environmental testing and reliability demonstration testing started in FY 86 and will continue in FY 1987 to support DT&E, IOT&E and a production decision in FY 1988. In FY 1987 environmental qualification testing (EQT), AFEWES IOT&E, and DT&E flight testing will be completed. IOT&E flight testing will begin. The ASPJ operational test program will be a joint service IOT&E.

Program Element: 64737F
DOD Mission Area: 371 - Self-Protection

Title: Airborne Self-Protection Jammer (ASPJ)
Budget Activity: 4 - Tactical Programs

The Air Force and Navy operational testers will share range assets, IOT&E data and will produce a joint IOT&E test report. In FY 1988, Initial Operational Test and Evaluation (IOT&E) and reliability qualification testing will be completed and F-16 software integration testing and the ASPJ [ ] Successful completion of IOT&E in FY 1988 will lead to a Milestone IIIA production decision in June 1988. Cost estimates are Cat ory I based on an independent cost estimate approved in June 1986. FY 1989 efforts consist of service unique operational flight testing in preparation for the Milestone IIIB decision planned for July 1989. Additional FY 1989 efforts will include F-16 software integration to ensure that the ASPJ system is able to interact with, and perform in, the F-16 electronic environment, as well as efforts to develop the Avionics Intermediate Station (AIS) software and hardware changes for depot level maintenance support and continuation of the [ ] program intended for incorporation in the F-16 ASPJ system in FY 1991/1992 timeframe.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project 2719, F-16 ASPJ Development/Integration.

A. (U) Project Description: This project supports unique engineering required for the integration of the ASPJ into the F-16 aircraft. This includes Group B development, operational testing, development of the F-16 ASPJ avionics rack, Electromagnetic Interference and Compatibility (EMI/EMC) testing, F-16 software integration/development testing and Intermediate and Organizational Level test equipment hardware and software development.

B. (U) Program Accomplishments and Future Efforts:

(1) FY 1986 Accomplishments: The ASPJ operated successfully against [ ] during laboratory testing conducted at Point Mugu Test Center, Air Force Electronic Warfare Evaluation System (AFEWES) and at Tynall AFB, FL. In this series of tests, the system successfully jammed multiple threats simultaneously [ ]

(2) (U) FY 1987 Program: ASPJ will undergo software and hardware optimization at PMTC, and environmental and reliability testing at the contractor's facility. F-16 ASPJ Development Test and Evaluation (DT&E) will be conducted at Eglin AFB, FL. At the conclusion of Eglin DT&E, the ASPJ will be certified ready for Operational Test and Evaluation (OT&E) and the AFEWES OT&E will be started concurrently with the OT&E flight test at Eglin AFB.

(3) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: In FY 1988, ASPJ will complete the bulk of the 3000 hour Reliability Demonstration Test and continue F-16 integration at the System Integration Laboratory at General Dynamics. The ASPJ will undergo extensive OT&E flight testing at the Eglin AFB Electromagnetic Test Environment (EMTE) range in preparation for the Milestone IIIA production decision in FY 1988. Hardware and software development for F-16 Intermediate and Organizational support equipment will also continue. Cost estimates are Category I in accordance with an ASPJ independent cost estimate approved in June 1986. This program is in Full-Scale Development

Program Element: 64737F — Title: Airborne Self-Protection Jammer (ASPJ)
DOD Mission Area: 371-Self-Protection — Budget Activity: #4-Tactical Programs

and is a joint development with Navy as the lead service with development done by the Joint Venture (JV) team of ITT Avionics and Westinghouse. In FY 1988, the JV will demonstrate that each half of the team can independently produce the entire ASPJ system. The Milestone IIIA limited production buy quantity will be equally split between each contractor team. The will also begin in FY 1988 and continue through FY 1991. This will be a common development between the Air Force and Navy with common "black boxes" developed for all aircraft scheduled to acquire this ASPJ pre-amplifier development for sensitivity improvement will also begin in FY 1988.

(4) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: In FY 1989, ASPJ will undergo Reliability Qualification Testing (RQT) to confirm that the system will perform in the F-16 flight envelope. The will continue in FY 1989 to develop a joint Navy/Air Force system applicable to all ASPJ aircraft. Air Force unique F-16 ASPJ operational flight testing will take place in FY 1989 at the flight ranges not already tested by the Air Force. The IIIB full-scale production decision is planned for 4Q FY 1989.

(5) Program to Completion: This is a continuing program. All OT&E should be completed in FY 1989 in preparation for the IIIB full-rate production decision. The should continue until FY 1991 along with several other ASPJ improvements, including sensitivity improvement, VHSIC insertion, second-generation Digital RF Memory (DRFM), ASPJ software improvement and advanced technology incorporation.

C. (U) Major Milestone:

Milestones	Dates
(1) (U) Joint Program Initiated	March 1975
(2) (U) DSARC II	July 1979
(3) (U) DSARC Program Review	January 1982
(4) (U) Initial Flight Testing Commenced	October 1986
(5) (U) JRMB Review	November 1986
(6) (U) DT Testing Complete	July 1987
(7) (U) JRMB Review	October 1987
(8) (U) ASPJ Joint OT&E Complete	February 1988
(9) (U) Milestone IIIA	May 1988
(10) (U) F-16 ASPJ OT&E Complete	March 1989
(11) (U) Milestone IIIB	July 1989

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64738F Title: Protective Systems
DOD Mission Area: 371 - Self-Protection Budget Activity: 3 - Strategic Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		42,918	64,088	53,384	83,213	Continuing	N/A
1627	Simulation, Analysis and Evaluation	12,397	17,000	31,725	30,208	Continuing	N/A
2114	Antenna Test Range	2,055	2,000	2,114	2,099	Continuing	N/A
5615	Strategic Protective Systems	23,225	44,088	19,545	50,906	Continuing	N/A
5616	F/FB-111 Protective Systems	5,241	1,000	0	0	Continuing	N/A

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides funds for: (1) the maintenance and update of computer threat simulations for evaluation and analysis of Electronic Warfare (EW) equipment; (2) maintenance and update of an antenna test range to support both ground and airborne evaluations of new EW antennas, including radiation patterns and antenna isolation measurements; (3) development of infrared, optical and equipment for strategic and tactical aircraft; and (4) engineering development of new or improved Electronic Countermeasures (ECM) equipment such as the ALQ-172(V) for the B-52 and aircraft.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	50,155	92,705	72,390	N/A	Continuing	N/A

EXPLANATION: FY 1986 funding difference results from Congressionally-mandated balanced budget reductions and reprogramming to higher priority projects. FY 1987 funding differences due to Congressional action. FY 1988 difference results from zero balance transfers to PE 64737F and PE 64739F, inflation adjusts, AFEWES reductions, and

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable

Program Element: 64738F Title: Protective Systems
DOD Mission Area: 371 - Self-Protection Budget Activity: 3 - Strategic Programs

5. (U) RELATED ACTIVITIES: The efforts in this program draw heavily on concepts and technology demonstrated in the advanced development PE 63743F, Electronic Combat Technology. Technology from other projects within this program element; PE 64739F, Tactical Protective Systems; PE 64326F, Strategic Conventional Standoff Capability; and other classified PEs is utilized to the maximum extent possible.

6. (U) WORK PERFORMED BY: The major contractors for Project 5615 are the Boeing Military Airplane Company, Wichita, KS; International Telephone and Telegraph Avionics Division, Nutley, NJ; EATON/AIL, Long Island, NY; and Motorola Government Electronics Division, Scottsdale, AZ. The major contractor for Projects 1627 and 5616 is General Dynamics Corporation, Ft. Worth, TX. There are ten additional contractors with a total contract value of approximately $21 million. The Air Force manager for Project 2114 is Air Force Systems Command, Electronic Systems Division, Rome Air Development Center, Griffiss AFB, NY. The Air Force manager for all remaining projects is Air Force Systems Command, Aeronautical Systems Division, Wright-Patterson AFB, OH.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

Project: 2114, Antenna Test Range. This project provides for the acquisition, maintenance and continuing update of a precision Electronic Warfare (EW) antenna test range employing reconditioned shells of actual USAF combat aircraft. Current aircraft shells available include F-4, F-111, A-10, F-15, F-16, B-52 and KC-135 aircraft. The range is used during advanced and full-scale development programs to test and evaluate new EW antennas and antenna installations on board actual aircraft to determine radiation patterns. During FY 1986, Real-Time Data Reduction updates were completed, [ ] instrumentation projects continued, and work was initiated on [ ] instrumentation for the Precision Antenna Measurement System. System isolation and range reflection measurements were taken at the Stockbridge, NY facility. A capability to evaluate Phased-Array Antenna Systems (PAAS) was addressed. FY 1987 will see continuation of the [ ] and PAAS evaluation projects. Efforts will be initiated to procure a [ ] In FY 1988, [ ] and PAAS projects will continue, as will efforts to procure a [ ] The [ ] and PAAS projects are scheduled to complete in FY 1989.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 1627, Simulation, Analysis and Evaluation

A. Project Description: This project develops, fabricates and validates laboratory simulations [ ] systems for detailed development and evaluation of potential countermeasures systems and techniques. The two major simulation facilities funded by this project are the Air Force Electronic Warfare Evaluation Simulator (AFEWES) and the Real-Time Electromagnetic Digitally-Controlled Analyzer and Processor (REDCAP). These facilities provide realistic laboratory simulations of [ ] (including [ ] evaluations) to permit effective definition, design and evaluation of new/improved countermeasures equipment in precisely-controlled environments. This permits extensive testing before flight test at a fraction of flight test cost for similar efforts.

Program Element: 64738F Title: Protective Systems
DOD Mission Area: 371 - Self-Protection Budget Activity: 3 - Strategic Programs

B. (U) Program Accomplishments and Future Efforts:

(1) FY 1986 Accomplishments: The AFEWES continued activity on simulations and began the simulation capability. Fabrication efforts were delayed on the A decision on a simulation will be made. The REDCAP began initial evaluation of the simulation including the electronic countermeasures testing. testing (Project 5615) was started at REDCAP.

(2) FY 1987 Program: AFEWES fabrication efforts continue on the simulations. activity will be completed, and the capability update will continue. Initial efforts on simulations will be undertaken. Planning for incorporation will continue. Evaluation of REDCAP upgrades will be made.

(3) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Fabrication of SA-6 and SA-8 simulations will continue. Modification to the system completes. simulation will be completed as well. will complete and contracts will be let for fabrication of a simulation. The budget estimates are Confidence Level IV and are based on similar work that has been accomplished in the past. Both the AFEWES and REDCAP upgrades are sole source activities that take place in government-owned/contractor-operated facilities. The funding estimates are current as of 29 August 1986.

(4) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Fabrication of simulations will be completed. interleaving with specific simulations will be accomplished for the first time. Airborne clutter simulation efforts will be initiated. Fabrication of the simulator will be started. Funding estimates are current as of 29 August 1986.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones:

Milestones	Dates
(1) ( ) Simulation Completed	1st Quarter 1987
(2) ( ) Contract Award	3rd Quarter 1987
(3) ( ) Completed	4th Quarter 1987

9. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 5615, Strategic Protective Systems:

Program Element: 64738F Title: Protective Systems
DOD Mission Area: 371 - Self-Protection Budget Activity: 3 - Strategic Programs

A. Project Description: This project provides for development of new and improved Electronic Countermeasures (ECM) for strategic bombers. The continued Soviet emphasis on improvements in quantity and quality of their air defense and command and control systems requires provisions for improved self-protection countermeasures systems for strategic bombers. This project funds the ALQ-172 countermeasures system development for B-52H aircraft

B. (U) Program Accomplishments and Future Efforts:

(1) FY 1986 Accomplishments: The ALQ-172 ECM system development continued. The primary efforts included sensor integration, continued Support Equipment (SE) interface development and an update of the software

Development of the capability continued. Testing at the REDCAP was conducted. Following completion of REDCAP testing, will will be made available to various airplane program offices. Due to funding constraints major efforts on development were deferred from FY 1986 to FY 1987.

(2) FY 1987 Program: Final incorporation of ALQ-172 software and final engineering of ALQ-172 tail installation will be completed. The development effort will continue with initiation of installation trade studies leading to the development and integration of both the Group A and Group B hardware for ground and flight testing. Additional risk-reduction programs will be conducted relative to potential applications. Sled testing and simulator testing of the (AAED) will be accomplished. AAED is a joint Navy, Air Force, Army program.

(3) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Based on outcome of the installation trade studies, risk reduction, and AAED tests, fabrication of prototype systems will begin on Electronic Countermeasures (ECM) upgrade. Antenna isolation, pattern measurement and ECM technique evaluations will be accomplished. Early stages of preparation for flight test will be initiated leading eventually to flight testing in FY 1991. estimate has a Confidence Level IV.

(4) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Installation of the selected upgrade will be accomplished. Should AAED testing prove promising, feasibility flight test on a surrogate aircraft is planned. Refinement of engineering decisions made during trade studies will be accomplished. Instrumentation packages necessary to collect and monitor data during combined Developmental Test & Evaluation/Initial Operational Test & Evaluation will be defined. Range and aircrew assets will be identified to perform flight testing in FY 1991. estimate has a Confidence Level IV.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones:

Program Element: 64738F
DOD Mission Area: 371 - Self-Protection

Title: Protective Systems
Budget Activity: 3 - Strategic Programs

	Milestones	Dates
(1)	Trade Studies Initiated	1st Quarter FY 1987
(2) (U)	AAED Sled Testing	3rd Quarter FY 1987
(3) (U)	B-52 ALQ-172 Full-Scale Development Complete	4th Quarter FY 1987
(4) ( )	Production Decison	3rd Quarter FY 1991

10. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64739F **Title:** Tactical Protective Systems
DOD Mission Area: 371 - Self-Protection **Budget Activity:** 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	43,845	41,083	49,077	55,994	Continuing	N/A
2272	F-16 Protective Systems	160	8,300	6,875	10,170	Continuing	N/A
2273	Integrated Electronic Warfare System	14,998	(Transfared to PE 63109F)			N/A	N/A
2274	Special Operations Aircraft Protective Systems	3,084	3,000	3,485	1,500	Continuing	N/A
2879	Area Reprogramming Capability (ARC)	16,250	12,000	15,600	16,200	Continuing	N/A
3106	A-10 Protective Systems	385	200	-	-	Continuing	N/A
3107	Special Mission Aircraft Protective Systems	1,371	1,600	1,100	1,442	Continuing	N/A
3158	Electronic Warfare Planning and Management	1,362	2,000	3,050	4,043	Continuing	N/A
3630	Joint Electronic Warfare Center (JEWC)	1,850	900	2,000	2,200	Continuing	N/A
5618	F-15 Protective Systems	4,385	13,083	16,967	20,439	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides for the engineering development of new and improved self-protection Electronic Warfare equipment for tactical strike, air superiority, airlift and reconnaissance aircraft. Projects in this Program Element respond to: Tactical Air Forces (TAF) Required Operational Capability (ROC) 303-76, F-16 Air Combat Fighter, 28 December 1976; TAF Statement of Operational Need (SON) 312-80, Optical Threat Acquisition and Cueing System, TAF SON 304-80, Tactical Self-Protection Electronic Warfare Systems, 9 May 1980; Strategic Air Command SON 06-80, Electronic Warfare Rapid Reprogramming Capability, 3 June 1980; and Military Airlift Command (MAC) SONs 07-81, 08-81, 09-81, Defensive Systems for Airlift, Combat Rescue Helicopters, and Combat Rescue HC-130 aircraft, 8 September 1981; MAC SON 05-83, Special Operations Combat Talon II Aircraft/Combat Talon Improvements, 21 January 1983; and TAF/Air Force Reserves SON 402-82, AC-130A/H Improvements, 3 January 1983.

Program Element: 64739F
DOD Mission Area: 371 - Self-Protection

Title: Tactical Protective Systems
Budget Activity: 4 - Tactical Programs

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
RDT&E	43,789	94,910	95,004	N/A	Continuing	N/A

EXPLANATION: (U) Major funding changes include: 1) Congressional action reduced the FY 1987 program by $53.827 Million ($40.0 Million from Project 2272 SEEK RAM); 2) FY 89 was reduced $45.927 Million as a result of the deletion of SEEK RAM funds ($-20.0 Million), the transfer of INEWS funding to PE 63109F and a 2.0 Million increase for JEWC and various other adjustments.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. RELATED ACTIVITIES: Project 2272, F-16 Protective Systems.

6. (U) WORK PERFORMED BY: This PE is administered at the Aeronautical Systems Division, Wright-Patterson Air Force Base, OH. Major contractors are Northrop Corporation, Defense Systems Division, Rolling Meadows, IL (ALQ-135 Internal Countermeasures Set and active Infrared Countermeasures (IRCM)); Loral Electronic Systems, Yonkers NY (ALR-56C RWR; Loral Electro-Optical Systems Division, Pasadena CA, for active IRCM); and Teledyne Systems Company, Northridge, CA (Area Reprogramming Capability (ARC)). There are additional contractors performing work having a combined total cost of $155,495 thousand from FY 1987 through FY 1989.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. Project: 2274, Special Operations Aircraft Protective Systems. This project develops EW equipments which form the self-protection suites for AC-130, MC-130 (Combat Talon), HH-53 and other special operations aircraft. Most tasks within this project tailor available equipment (such as RWRs, infrared jammers, chaff flares and dispensers) or equipment under development in other projects within the PE (such as the ALE-47 and ARC system) for application to special operations aircraft. The unique, funded task within this project is to evaluate the application of a

Development Breasboard development will be initiated in FY 1987 and will include two flight qualified systems to be used for antenna pattern definition at Rome Air Development Center and flight testing to be accomplished in FY 1989. Flight test results will be used to make a Full Scale Development decision in FY 1989.

Program Element: 64739F Title: Tactical Protective Systems
DOD Mission Area: 371 - Self-Protection Budget Activity: 4.- Tactical Programs

B. Project: 3107, Special Mission Aircraft Protective Systems. This project develops EW equipments which form the self-protection suites for the [ ] which are consistent with the political and threat environments in which these aircraft operate. Although there are ongoing study and analysis efforts to define the opportunities for using existing equipment (such as chaff and flare dispensers, Radar Warning Receivers (RWRs) and radar jammers) to protect high value aircraft, the primary task within this project is [ ]

An integral part of this IR jammer Quick-Reaction Capability (QRC) effort is to expand coverage to [ ] IR jammer protection and to develop modulation techniques which will counter [ ] A source selection has been delayed to add 1990 threat data to the RFP. The Source Selection will down select to one of three contractors to begin FSD in FY 1987 expecting completion in FY 1989. The system will replace the interim IRCM system on the [ ]

C. (U) Project: 3158, Electronic Warfare Planning and Management. This project involves the development of the Electronic Combat Digital Evaluation System (ECDES), a multilevel, integrated, digital evaluation system which can perform weapons systems survivability analysis and electronic combat system design tradeoff analysis. This system will be developed into a standard modeling capability to be used by DOD and industry, thereby reducing duplication and program costs. Ongoing FSD continues throughout FY 1986. Preliminary Design Review and Critical Design Review will occur in FY 1987. Actual construction of the ECDES hardware begins in the final quarter of FY 1987. Interim Operational Capability for ECDES is projected to be accomplished in FY 1988. Development of a portable integrated simulation system begins in FY 1989. Another project formulates a plan for insertion of Very High Speed Integrated Circuit (VHSIC) technology into current and near-term RWRs and Electronic Countermeasures (ECM) systems. The goal is to use common VHSIC modules which can be applied to similar systems which have different architectures. For example, it may be possible to utilize a VHSIC signal sorting module with both the ALR-56C and the ALR-69 RWR family. Similar opportunities may exist for developing modules common to the ALQ-131 pod, ALQ-135 and ALQ-165 ECM systems. ASD will provide a VHSIC insertion roadmap to exploit VHSIC development under INEWS/ATF, etc., for inclusion into F-15/16 systems.

D. (U) Project: 3630, Joint Electronic Warfare Center (JEWC). This project identifies various 6.2/6.3 projects within AF/Navy labs and provides management and funds to expedite the movement of the project to a 6.4 effort. Critical Joint program needs are therefore enhanced by the JEWC efforts. Planned programs for FY 1988/89 include investigation of generic threat identifier techniques which will allow tactical electronic support measure (ESM) systems to identify and categorize unknown or new threat emissions; potential means of updating electronic order of battle (EOB) on combat aircraft; spread spectrum and frequency hopping countermeasures; infrared obscurants; laser countermeasures; and anti-radiation missile decoys.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2272, F-16 Protective Systems

A. Project Description: This project develops EW equipments which form the F-16 self-protection suite. Specific tasks include: a project to develop [ ] techniques to counter [ ]

interceptors, advanced surface-to-air missile and anti-aircraft artillery systems; automatic, threat adaptive ALE-47 Countermeasures Dispenser to be integrated with the Airborne Self-Protection Jammer/advanced RWR-equipped F-16 C/D and optical threat acquisition and countermeasures systems; advanced chaff for countering future Soviet threats. The project is developing an Onboard Electronic Warfare Simulator (OBEWS) for crew member training.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: ALE-47 Request For Proposal (RFP) was released. Source selection for ALE-47 program began August 1986. Mr Godwin, the USD(Acq) directed that the AF and NAVY develop a JOINT ALE-47 Countermeasures Dispenser System. The source selection is on hold while the AF, as the lead service, develops a Tri-service program. A JOINT AF/ARMY/NAVY Memorandum of Understanding should be approved by the Assistant Service Secretaries in JAN 87. The AF goal is to have the ALE-47 CMDS available for the F-16 Blk 70 Jun 91 IOC.

(2) FY 1987 Program: Full Scale Development (FSD) of [ ] will begin along with the FSD contract award for the ALE-47 Countermeasures Dispenser (CMD). The DT&E flight test effort for the Onboard Electronic Warfare Simulator (OBEWS) will be commence. The data package for RR #180 Dual chaff squibs will be acquired.

(3) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The FY 1988 planned program will continue ongoing efforts to field effective, affordable self-protection on combat-tasked F-16s. Funds requested are essential to meet F-16 Blk 70 development, production and deployment milestones. Twelve ALE-47 pre-production units will be delivered to USAF for testing. Reliability and qualification testing will commence on the ALE-47. Program costing was reviewed in June 1986; cost estimates are Category IV based on experience by the Air Force Systems Command systems program office with current similar development programs. DT&E will conclude 1Q FY 1988, IOT&E will commence and conclude with an OBEWS Phase III decision in the 4Q FY 1988. FSD of [ ] will continue.

(4) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Several 6.3 lab efforts funded in PE 63743 are about to be transferred to this 6.4 PE. Coronet Prince and Compass Hammer are funded through FY 1988 with a transition to this PE in FY 1989. The Full-Scale Development (FSD) of the Optical Threat Acquisition and Countermeasure (OPTAC) system is projected to begin in FY 1989. JOINT ALE-47 DT&E/IOT&E flight testing will commence in FY 1989. FSD of [ ] for the F-16 will continue. Program costing was reviewed in June 1986; cost estimates are Category IV based on experience by the Air Force Systems Command systems program office with current similar development programs. Various [ ] currently funded with 6.3 dollars are programmed to depart the labs for FSD in FY 1989. FSD will begin with [ ]

(5) Program to Completion: This is a continuing program to develop enhanced self-protection capabilities for the F-16 with production funds identified in the weapon system program element. The [ ] development program will continue. The flight testing is scheduled to commence in April 1991 with limited production deliveries beginning October 1994. A production decision on the ALE-47 program is scheduled for December 1989 with deliveries commencing in September 1990.

C. (U) Major Milestones

Milestones		Dates
(1) (U) ALE-47 Preliminary FSD Contract Award		Sep 1983
(2) (U) ALE-47 FSD Contract Award		***Mar 1987
(3) [ ] Development Contract Award		*Jun 1987
(4) (U) ALE-47 DT&E/IOT&E Flight Testing		***Apr 1989
(5) (U) OPTAC (EO Countermeasure) FSD Contract Award		*Feb 1989
(6) (U) ALE-47 Production Decision	**(Oct 1989)	***Dec 1989
(7) (U) ALE-47 Production Deliveries	**(Apr 1990)	***Sep 1990
(8) ( ) [ ] DT&E/IOT&E		Apr 1991
(9) ( ) [ ] Limited Production Deliveries		Oct 1994

*New milestones not included in FY 1987 Descriptive Summary
**Date presented in FY 1987 Descriptive Summary
***Dates should change when JOINT program schedule is firmed up

(U) Explanation of Milestone Changes

(6),(7) (U) ALE-47 Production Decision, Flight Testing and deliveries were slipped due to the transition to a JOINT AF/ARMY/NAVY program.

9. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2879, Area Reprogramming Capability (ARC).

A. Project Description: ARC will provide the using commands with the capability to rapidly respond to [ ] This will be accomplished by changing data software in a wide range of Electronic Warfare (EW) Systems and RWRs, via the ARC console. The ARC is a software intensive, computerized system that will allow the operators to assess the impact of threat parameter changes (e.g., [ ] on EW systems, establish and select realistic reprogramming options for the EW system software, test the options, and create and document the changes to the EW system software programs. The ARC program updates the existing manual approach achieving a rapid and accurate in-field response.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: The third Critical Design Review was completed Aug 86. Hardware and some software integration began.

(2) (U) FY 1987 Program: Integration and testing will continue with the delivery to HQ SAC of an interim ARC to support the B-1 ALQ-161 defensive system.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The FY 1988 planned program continues integration and testing with the start of DT&E.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Preparations will be made to install ARC systems at Headquarters SAC, Tactical Air Warfare Center (TAWC) and Warner Robins Air Logistics Center (WRALC). OT&E will be initiated in FY 1989 and a decision made for software development for follow-on reprogrammable EW systems. Final installation at WRALC, SAC and TAWC will occur.

(5) (U) Program to Completion: Phase II of the program will commence in FY 1990 after the successful conclusion of Phase I. Additional systems will be contracted with a prioritized list of EW systems to be simulated and integrated into the ARC baseline program.

C. (U) Major Milestones:

Milestones	Dates
(1) (U) ARC Contract	Feb 1984
(2) (U) CDR #3 Completion	Apr 1986
(3) (U) Hardware and Software Integration	Mar 1986
(4) (U) Interim ARC Delivery	Jun 1987
(5) (U) DT&E	Oct 1987
(6) (U) System Delivery	Apr 1990

10. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 5618, F-15 Protective Systems

A. Project Description: This project develops the Tactical Electronic Warfare System (TEWS), improvement and upgrades to the F-15 self-protection suite. The F-15 TEWS consists of the ALR-56A Radar Warning Receiver (RWR), the ALQ-135 Internal Countermeasures System, the ALQ-128 Electronic Warfare Warning System and the ALE-45 Countermeasures Dispenser (CMD). Upgrades of the ALR-56A to the ALR-56C configuration, of the ALQ-135 to include Band 3/1.5 capabilities and a CMD interfaced with the RWR are required to provide effective aircrew warning and countermeasures against the threat and sophisticated surface-to-air threats. These tasks constitute an ongoing program to develop self-protection capabilities which will permit the F-15 to accomplish its combat tasking in a technologically advanced, dense threat environment.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Full-up ALR-56C and ALQ-135 hardware and software development integration and testing, to include productionizing of the prototype equipment (reliability and maintainability improvements, etc.)

began. Additional efforts include ALR-56C and ALQ-135 software updates in response to threat changes which have occurre since the prototype systems were baselined. ALR-56C and ALQ-135 integration efforts continue to optimize systems effectiveness. The ALR-56C Very High Speed Integrated Circuit (VHSIC) application study and design concept began. Contract has been awarded for the MJU-10 flare. Ground testing and development flight testing of the individual ALR-56 and ALQ-135 Quick Reaction Capability (QRC) systems has begun.

(2) FY 1987 Program: Productionizing of the ALQ-135 Band 3 hardware and development of the Band 1.5 system will be completed. Initial Operational Test and Evaluation (IOT&E) of the ALR-56C, ALQ-128 and ALQ-135 Band 3 TEWS suite will begin. Production decision for the F-15E TEWS is scheduled. F-15 test aircraft will be modified to accommodate continuing software and hardware testing of production equipment. Software updates to the ALR-56, ALQ-135 and ALE-45 will continue in response to threat parameter changes. Deliveries of the Quick Reaction Capability (QRC) ALQ-135 Band 3 systems will be completed. An ALQ-135 sensitivity study contract will be awarded in FY 1987. An effort will be initiated to determine the best, most cost effective incorporation of [ ] into the ALQ-135 update program. A production decision will be made on the ALQ-135 Band 1.5 in August 1987. Phase IV of the F-15 TEWS integration flight testing which includes the ALE-45, ALR-56C, ALQ-128, and the ALQ-135 will commence.

(3) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Phase IV F-15 TEWS integration flight testing will be completed. ALR-56C VHSIC fabrication and testing will be completed. Award of a FSD contract for the development of ALQ-135 [ ] *Efforts will begin to study software integration enhancements for* the ALE-45. DT&E/ IOT&E flight testing of the ALQ-135 Band 1.5 will begin. An analysis of F-15 RF interoperability will commence. Costs are category IV based on experience of the F-15 Systems Program Office with current, similar development programs. Program costing was reviewed in June 1986.

(4) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: ALQ-135 Band 1.5 deliveries will begin. FSD of [ ] incorporation into ALQ-135 will continue. Incorporation of enhancements for F-15 system interoperability will begin. Efforts will continue on ALE-45 enhancements. Towed decoy development at the 6.3 PE level will be moving to FSD. We expect FSD to commence in FY 1989 and continue for several years. The towed decoy is a potentially lucrative counter to various [ ] threats. Cost estimates are category IV based on experience of the Air Force Systems Command Systems Program Office with current, similar development programs. Program costing was reviewed in June 1986.

(5) Program to Completion: This is a continuing program to develop self-protection capabilities for the F-15. The continuing program includes development of [ ] and more extensive integration of the F-15 TEWS with other aircraft avionics such as the fire control radar [ ], to enhance F-15 offensive capability and survivability. An ALR-56C VHSIC production decision will be made in FY 1990. Efforts will also begin to evaluate potential of VHSIC application to other F-15 EW systems and also the potential use of artificial intelligence.

Program Element: 64739F — Title: Tactical Protective Systems
DOD Mission Area: 371 - Self-Protection — Budget Activity: 4 - Tactical Programs

C. (U) Major Milestones:

		Milestones		Dates
(1)	(U)	ALE-45 Countermeasures Dispenser (CMD) Development Contract Award		Jun 1978
(2)	(U)	ALR-56C Radar Warning Receiver (RWR) Development Contract Award		Aug 1981
(3)	(U)	ALE-45 CMD Development Test and Evaluation (DT&E) Flight Test		Dec 1981
(4)	(U)	ALE-45 CMD IOT&E Flight Test		Dec 1982
(5)	(U)	ALQ-135 Internal Countermeasures System (ICS) Quick Reaction Capabilities (QRC) Band 3 Development Contract Award		Feb 1983
(6)	(U)	ALQ-135 ICS Band 1.5 Preliminary Development Contract Award	*(Sep 1983)	Mar 1985
(7)	(U)	ALQ-135 ICS QRC Band 3 Ground Test		Nov 1983
(8)	(U)	ALR-56C RWR Ground Test		Apr 1984
(9)	(U)	ALQ-135 ICS QRC Band 3 DT&E Flight Test	*(Apr 1984)	May 1986
(10)	(U)	ALQ-135 ICS Band 1.5 Critical Design Review	*(Dec 1984)	Nov 1986
(11)	(U)	ALR-56C Deliveries	*(Mar 1985)	May 1986
(12)	(U)	ALQ-135 Band 3 QRC Deliveries		Feb 1986
(13)	(U)	ALR-56C DT&E/IOT&E Flight Test (concurrent)		Oct 1985
(14)	(U)	ALQ-135 ICS Band 3 QRC DT&E/IOT&E Flight Test	*(Dec 1985)	May 1986
(15)	(U)	ALE-45 CMD Production Deliveries	*(Mar 1986)	Jul 1986
(16)	(U)	Integrated F-15 Tactical Electronic Warfare System (TEWS) Flight Test	*(Sep 1986)	Jun 1987
(17)		[		]
(18)	(U)	ALQ-135 Band 1.5 Production Decision		Aug 1987
(19)	(U)	ALR-56C Millimeter Wave Warning/Passive Target Identification Development Contract Award		Dec 1988
(20)	(U)	ALQ-135 Band 1.5 production deliveries		Aug 1989

*Dates presented in FY 1987 Descriptive Summary

(U) Explanation of Milestone Changes

(6,9,10,11,12,17) Developmental Problems
(14) Delay in contractor delivery of test units
(15) Delay due to production problems at manufacturer's facility
(16) Delayed because of earlier slips in flight testing

11. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64740F
DOD Mission Area: 440 - Technical Integration/Studies and Analyses

Title: Computer Resource Management Technology
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		11,750	10,633	20,367	21,667	Continuing	N/A
2239	Computer Security Tech	1,432	1,580	1,559	1,600	Continuing	N/A
2522	Requirements Analysis	1,086	952	1,944	2,154	Continuing	N/A
2523	Management Control Tech	674	890	1,124	1,430	Continuing	N/A
2524	Policy & Procedure Guidance	1,323	1,000	1,792	2,029	Continuing	N/A
2526	Software Engineering Tools & Methods	1,332	920	1,692	1,892	Continuing	N/A
2983	Logistics Info. Mgmt. Support Sys. (LIMSS)	4,894	4,800	7,691	8,836	Continuing	N/A
3315	Automation of Technical Information	1,009	491	4,565	3,726	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This is an engineering development program that addresses problems of acquiring computer resources embedded in Air Force systems. This PE is a primary vehicle for transferring the products of advanced development efforts in computer resource technology into system applications. The objectives are to identify, develop and transfer into active use, tools, techniques and computer technology advances that support the following: (1) Providing reliable, survivable and secure systems, (2) Reducing software development and support costs, (3) Providing timely development and support of computer resource products, (4) Enhancing in house productivity and the ability to acquire and support systems, (5) Providing a totally integrated capability to create, accept, retrieve and store digital (paperless) technical information for life cycle support for Air Force Logistics Information Systems. Excludes civilian and military manpower and their related costs and military construction costs which are included in appropriate management and support elements in this program.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	11,705	12,957	18,689	N/A	Continuing	N/A

EXPLANATION: (U) - The FY 1987 decrease is due to Congressional reduction. The FY 1988 delta accommodates Office of the Secretary of Defense (OSD) initiatives.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITES: This Program Element (PE) complements the DOD Software Initiatives (PE 63756), ADA (PE 63226F), and the Software Engineering Institute (SEI) (PE 63752F). It is related to PE 63728F, Advanced Computer Technology and PE 27595F, Base Communications Tactical Air Forces and PE 63106F, Logistics Systems Technology. The Joint Logistics Commanders (JLC) efforts are in computer resources product assurance and standardization supported through this program. The Air Force's computer and software technology transitorizing efforts are supported by this P.E. and are coordinated through technical reviews at the staff and engineering levels. Coordination with other Services is done through the DOD Computer Security Center and the OSD program management reviews.

6. (U) WORK PERFORMED BY: The Electronic Systems Division (ESD), Hanscom AFB MA, has management responsibilities for the program except for Project 3315, which is managed by the Deputy Chief of Staff for Product Assurance and Acquisition Logistics, Headquarters, Air Force Systems Command (AFSC), Andrews AFB MD. Seven AFSC organizations are actively participating in tasks funded under this PE. Contractors include the MITRE Corporation (all projects), Bedford, MA; Dynamics Research Corporation (Projects 2523 and 2524), Wilmington, MA; Aerospace (Projects 2239, 2522, 2524, and 2526), Los Angeles, CA; Logicon (Project 2523), San Pedro, CA; Advanced Technology Corporation (Project 2523), Reston, VA; Softech (Project 2526), Waltham, MA; Support Systems Associates (Project 2239), Lexington, MA; Intermetrics Incorporated (Project 2526), Cambridge, MA; Dynatrend Incorporated (Project 3315), Cambridge, MA; Computer Development Corporation (Project 3315) Cambridge, MA; Transportation Systems Center (Project 3315), Cambridge, MA; and CACI (Project 3315), Arlington, VA.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 2239, Computer Security Technology. Develop technologies, techniques, and validation procedures for use in Air Force/DOD systems in response to the DOD Computer Security Initiative 5215.1. This project concentrates on: demonstration and transition of "trusted" (i.e. security proven) systems and security mechanisms; enhancement and support of computer security verification/validation procedures; and computer security support to the acquisition of Air Force systems and to the Air Force Computer Security Program Office. In FY 1986, this project: completed reports on Small Secure Product Evaluation, and Secure Communication Process Application; developed guidelines for a computer security test and evaluation plan for use by all Air Force installations; began engineering development of a Multi-Level Secure Data Base Management Syatem (DBMS), the prototype of which was demonstrated in FY 1985; continued work on a trusted local area network; started development work needed to meet the Computer Security requirement of Strategic Air Command's (SAC) Statement of Need (SON) 10-82; initiated a task to implement a user authentication device using expert system technology; examined potential applications of the recently developed Secure Communications Processor and completed the Risk Analysis Environmenta Guide. In FY 1987 the project will develop a Secure Database Design Specification; begin work on a task to provide guidance on application of formal verification if software systems, initiate an effort to develop a computer security risk management system; explore aids to assist in software verification; develop a Multi-level Secure Data Base Management System (DBMS) and a Secure Local Area Network; and continue work on Strategic Air Command's (SAC) Statement of Need (SON) 10-82 and on user authentication tools. FY 1988 tasks include the following: continue engineering development of the Multi-level Secure DBMS, complete the advanced user authentication work,

initiate a task in audit trail analysis, continue efforts for the Secure Local Area Network, computer security risk management tool and formal software system verification guidance. In FY 1989, efforts will continue development work for Strategic Air Commands (SAC) Statement of Need (SON) 10-82; complete the implementation of the Multi-level secure DBMS continue development of the computer security risk management tool; initiate development of a threat modeling system; continue work on the automated audit trail analysis project; continue the formal verification task; complete secure local area network implementation; and initiate data aggregation analysis and High Order Language (HOL) verification tasks. This is a continuing program closely coordinated with National Security Agency/Department of Defense (NSA/DOD) Computer Security Center.

B. (U) Project: 2522, Requirements Analysis. Develop and apply tools that provide Air Force program offices with rapid insight into the technical performance, cost, schedule, and high risk implications of stated computer resources system requirements. These tools structure and control changing requirements; explore performance and supportability trade-offs; and examine alternatives prior to making hardware, software, and financial commitments. This project also assists users in their initial application of these requirements analysis and tracking tools. In FY 1986, the project: published User System Interface Design guidelines; conducted shakedown and initial application of the Data Base Design and Evaluation Workbench; began development of a Rapid Display Prototyping System (RDPS); implemented user-requested enhancements to Automated Interactive Simulation Modeling System; and conducted an evaluation of Space Division's System Integrity Diagnosis prototype system. To ensure quick and easy transition of tools to using agencies, computer aided instruction techniques were employed for each automated tool developed. These efforts will continue in FY 1987. Also, in FY 1987, the project will begin application of Space Division's Software Requirements evaluation criteria. In FY 1988, the project will: continue development of the RDPS; continue application of Space Division's software requirements (B-5 specification) evaluation criteria; begin work on a computer architecture requirements study; and begin development of a system integrity diagnosis expert system. In FY 1989, the project will: complete development of the RDPS; continue development on a decision support system for simulation development; complete work on a computer architecture requirements study; continue development of a system integrity diagnosis expert system; continue development of an automated tool to assist systems engineers in generating and organizing concepts; and begin development of an automated system life cycle environment. This is a continuing program driven by new state-of-the-art requirements.

C. (U) Project: 2523, Management Control Technology. Develop and evaluate methods for estimating software development costs and defining acquisition strategies and practices that aid in the control of mission-critical computer resources. Efforts will support the Joint Logistics Commanders objectives to eliminate unnecessary duplication and proliferation of software acquisition standards and practices among the three Services. In FY 1986, this project: presented training courses for DOD-STD-2167, Defense System Software Development and complete courses for DOD-STD-2168, "Software Quality Standard" (SQS); continued to support the Joint Logistics Commanders (JLC) work; continued to transition the Software Quality Metrics technology developed under PE 63728F, Advanced Computer Technology; began initial design work for a Software Technology Transition and Support (STT&S) center; began development of a Mission Critical Computer Resource (MCCR) Standardization Plan; and developed a software sizing tool. In FY 1987, this project will: continue the transition of the Software Quality Metrics technology; continue to provide support to the JLC; continue design and begin implementation work for Metrics technology for Space Systems; continue implementation of the Software

Technology Transition and Support Center (STT&S) center; and continue development of the software cost estimating tool. In FY 1989, this project will: continue development of the Program Managers Decision Aid; continue evaluation of Software Quality metrics for space systems; continue implementation of the STT&S Center; continue development of the software cost estimating tool; and continue development of Ada quality guidelines. This is a continuing program tailored to transitioning new technology advances.

D. (U) Project: 2524, Policy and Procedure Guidance. Develop comprehensive guidance on policies and procedures that lead to improvements in the planning, acquisition, and support of mission critical computer resources. Through the use of guidebooks, video tapes, multimedia training methods, and automated management aids, this project will provide training to Air Force personnel in software acquisition management. In FY 1986, this project completed the Space Division MIL-Prime document, Flight Critical Systems Handbook, and the Computer Based Instruction (CBI) tasks; initiated work on software prototyping protocol, and the current and future use of acquisition guidebooks were examined. In FY 1987 the project will; develop C-5 evaluation criteria, and test plans/procedures evaluation criteria; develop a plan, and initiate work, to provide acquisition information and support to System Program Office (SPO) engineers; support enhancements to the Training and Performance Support System and the development and integration of a prototype combined training facility; initiate additional Computer Bases Instruction (CBI) courses; continue the work to develop software acquisition guides for SPO engineers; and complete the critical software prototyping protocol, C-5 evaluation criteria, and test plans/procedures evaluation criteria tasks. In FY 1988 the project will: complete the CBI applications, test plans/procedures and Software Products and Software Product Specification evaluation criteria, optical disc job aid, and Computer Resource Acquisition Course CBI reinforcement. In FY 1989 the project will: initiate work on the Computer Resource Acquisition Support Workstation, Training and Performance Support System Plan, and Software Specification Generation and Evaluation Tool; continue work on the Acquisition Guidebooks Update task and development of the Computer Resource Handbook; and complete the Optical Disc/Read-Only Memory (ROM) Handbook. This is a continuing effort driven by need for new policy/procedures generated by state-of-the-art computer system architectures.

E. (U) Project: 2526, Software Engineering Tools and Methods. Develop and implement a comprehensive set of integrated tools to improve the software development, acquisition, and support (e.g., maintenance) processes. In addition, this project will place major emphasis on providing planning and support for the introduction of the Ada High Order Language (HOL) into the Air Force and the introduction of Artificial Intelligence to improve engineering approaches to software development. In FY 1986: completed Lessons Learned Report on actual Ada application; supplemented the "Program Manager's Guide to Ada"; developed guidelines for a pictorial Notation Standard for Ada Designs in C5 product specifications; continued the Ada Production Quality Compiler definition task; initiated the development of an Expert Missile Maintenance Aid (EMMA). In 1987, will continue Program Manager Guide Supplement; demonstrate Ada software reusability; continue development of the EMMA; complete the Ada Production Quality Compiler definition; begin work to redesign Joint Interoperability Tactical Command/Control System (JINTACS) Automated Message System software in Ada; explore applications of Artificial Intelligence throughout the software development life cycle; and complete the Real-Time Run-Time Environments Study. In FY 1988; test and evaluate the effectiveness of using an integrated Ada programming environment in an Air Force System Software Development Project; determine the feasability of applying real time expert system technology to satellite control; demonstrate Ada's applicability to tactical missile software in a complete armament system (AGM-130 Digital Autopilot) using a transitional (JOVIAL to Ada)

development approach; and prepare guidelines to be used as the basis for a transitional development for Joint Interoperability Tactical Command/Control System (JINTACS) Automated Message System (JAMPS). In FY 1989, this project will: complete and deliver the Expert Missile Maintenance Aid (EMMA), finalize, install, and test the intelligent database search and retrieval system; test and report Ada's applicability to tactical missile software in a complete armament system; continue preparation of guidelines to be used as the basis for a transitional development of JAMPS for using Ada as the Higher Order Language (HOL); implement experimental real-time system technology in satellite control; provide an analysis to determine expert systems application to avionics; report finding and publish a guide for the use of an integrated Ada programming environment; improve programmer productivity through development of software engineering tools. This is a continuing project driven by advances in software technology including artificial intelligence

F. (U) Project: 2983, Logistics Information Management Support System (LIMSS). This is a long term development effort to provide a standard architecture and a Communications, Command and Control (C^3) infrastructure that will network various logistics information systems. This will improve wartime capability by improving information access, timeliness, and accuracy. The program will provide a broad plan to integrate the various logistics information systems being developed autonomously. Program responsibilities include overall planning, coordination, systems engineering, integration, test, and implementation. In FY 1986, this project: completed initial phase of strategic information planning for logistics, including a comprehensive plan, a detailed architecture for maintenance systems and base information analysis for transportation systems; furthered the integration of maintenance information systems by baselining the functional description for the Reliability and Maintainability Information Systems (REMIS), completed distributed network design for Core Automated Maintenance System (CAMS) and established the CAMS/standard base supply system (SBSS)/REMIS interface control working group; started a pilot project for validating the Cargo Movement Operation System concept. FY 1987: The LIMSS program will complete an Air Force-wide logistics information systems architecture and implementation plan for developing, integrating and fielding new information systems and improvements to existing capabilities. The design will use recently-developed local and wide area network technology, emerging data base management systems and fourth generation programming techniques which will permit greater survivability and deployability and more rapid evolution of information support for combat effectiveness. The LIMSS program office has established permanent liason with the Computer Aided Logistics Support (CALS) program to ensure incorporation of CALS objectives in the architecture. LIMSS will maintain a data base or clearing house of logistics information systems and initiatives. Through the LIMSS interface control working group, the first segment of an integrated network of systems the CAMS and REMIS on-line interactive link will be designed and tested. Integration coordination will continue in the supply and transportation functions with the goal of creating a seamless logistics information systems environment. FY 1988: The LIMSS program will coordinate the implementation of the logistics information system architecture by expanding the interface control working group to cover all major interactive links of the network of systems. Physical connectivity will be achieved through the conversion of recurring information transmissions to the Defense Data Network and Local Area Networks as they are installed. The architecture will be refined and revised to accomodate changing technology and requirements and the results of the Base Information Analysis and Air Force Logistics Command (AFLC) enterprise modelling will be incorporated. The first segment of the integrated network will be deployed providing approximately 1/3 of Air Force operational units with a logistics readiness and product performance link with their AFLC and Air Force Systems Command (AFSC) engineering and support infrastructure. In FY 1989: Additional units and systems will be

incorporated into the integrated network of information systems with emphasis on those units operating in deployed locations and hostile environments. This project is continuous until the National Academy of Sciences recommendation of a seamless logistics management environment is attained.

G. (U) Project: 3315, Automation of Technical Information (ATI). DOD Defense Guidance and Office of the Secretary of Defense (OSD) funding initiatives have emphasized the need to improve the preparation, delivery, use and updating of technical information used in the design, manufacture, maintenance and operation of DOD weapon systems. Currently, a variety of initiatives are underway to automate technical information and logistics support data. In FY 1986 this project established a management integration office (MIO) to implement Computer Aided Logistics Support (CALS). The MIO developed and coordinated a CALS program management plan, an implementation plan, and a demonstration plan. Through an interagency agreement, the U.S. Department of Transportation (DOT), Transportations Systems Center (TSC) provided technical support to the MIO. TSC is a federal Research and Development (R&D) facility for logistics, transportation, and information systems. TCS will develop a systems integration model that provides a single, automated methodology for assembling, updating, and extending present and future descriptions, interchange requirements, and interface controls. In FY 1987 this project will: initiate research toward developing a demonstration plan and a system integration model. In addition, the MIO will develop and coordinate a CALS 5 year strategic plan. In FY 1988 this project will: conduct architectural studies; initiate development projects which, combined with the architectural studies, will define the CALS concept. It will pursue implementation of CALS projects on current and planned weapon systems. In FY 1989 this project will: continue the implementation of CALS and maintain the related plans. Future efforts will continue to integrate/manage the overall design integration and maintenance of a logistics environment satisfactory to meet Air Force needs and Congressional direction.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: #64750F
DOD Mission Area: #327 - TIARA for Tactical Air Warfare

Title: Intelligence Equipment
Budget Activity: #4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		12,138	10,070	5,928	4,880	Continuing	N/A
1174	Intelligence Security Equipment	1,117	852	844	921	Continuing	N/A
1955	Air Force Support to DOD Indications & Warning	7,335	7,130	2,959	1,519	0	18,943*
2053	Foreign Technology Division Intelligence Processes	3,686	2,088	2,125	2,440	Continuing	N/A

*Funds to support this continuing project were cancelled at a contract phase point, effective in FY 1990; this value represents the project total for FY 1986 through FY 1989.

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Program Element supports USAF operating commands by performing the engineering development of ground equipment and/or techniques used to process, integrate, display and distribute intelligence data. This equipment will reduce the time required for the exploitation of intelligence data to meet the needs of Air Force agencies producing strategic, tactical, and scientific and technical intelligence. Equipment and techniques are also developed to counter the foreign intelligence threat to the USAF mission. In those cases where contractor estimates exist, this program is budgeted at the most likely cost and does not differ materially from known contractor estimates.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	13,138	10,417	7,091	N/A	Continuing	N/A

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. RELATED ACTIVITIES: Operation and maintenance (O&M) as well as procurement funds for the equipment developed in the Intelligence Security Equipment project are in PEs 35127F (Foreign Counterintelligence) and 35128F (Security and Investigative Activities). The R&D efforts in this project are coordinated with the
This prevents duplication of effort and promotes an exchange of capabilities among its members. The indications and warning project receives O&M

and procurement funds from PEs 31328F (Strategic Air Command) 31334F (Air Force Other Commands) and 31335F (Air Force Automated Data Processing Support). The RDT&E funding from this program as well as funds from the PEs mentioned above are combined together into a single integrated effort which is managed by the Rome Air Development Center, Griffiss AFB NY. The Intelligence Processes project at Foreign Technology Division develops software, equipment and analysis methods which are supported in PE 31310F (Foreign Technology Division).

6. (U) WORK PERFORMED BY: Major contractors are Planning Research Corporation (Project 1955), McLean, VA; International Computing Company (Projects 1955, 2053), McLean, VA; Booz-Allen-Hamilton (Project 1955), Bethesda, MD; AVCO (Project 2053), Wilmington, MA; and Pattern Analysis and Recognition Company (Project 1955), New Hartford, NY. In addition, there are 15 other contractors with a total current contract value of $7,982 thousand (for Projects 1174, 1955 and 2053).

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. Project: 1174, Intelligence Security Equipment. This project provides RDT&E funds to the Air Force Office of Special Investigations (AFOSI) to support the development of sophisticated equipment to This program, called Technical Surveillance Countermeasures (TSCM), is an essential part of the AFOSI effort in counterintelligence and counterespionage. With the constantly changing state-of-the-art in electronics and covert communications, AFOSI needs a research and development program to maintain its effectiveness in this mission area. This project fulfills that need with the specialized equipment required to perform the TSCM mission. Several independent tasks are conducted simultaneously; as tasks are completed, others are initiated to satisfy outstanding, validated requirements. Several tasks were completed during FY 1986. These include development and fabrication of a for criminal and fraud investigations, and a broadband countermeasures antenna for use with all current and projected countermeasures receivers in TSCM surveys. In addition, a signal processor was completed as part of a A short study was initiated to evaluate use of a low-cost, This task was an off-shoot of an FY 1985-1986 exploratory development study investigating techniques. During FY 1986, the project also continued development of an automated that can quickly and continuously Three new tasks were initiated in FY 1986. The project began design and fabrication of an The project also funded development of a and began the design of a complete During FY 1987, the project will complete the development of the automated and evaluation of the It will continue development of the the and the Due to funding limitations, there will be no new starts in FY 1987. During FY 1988 the project will complete development and fabrication of the and will continue development of the In FY 1989, the project will complete development and fabrication of the and initiate three follow-on tasks. One task will add enhancements to the automated

completed in FY 1987. The project will fund advanced development of the designed in the FY 1986-1988 exploratory development study. In addition, the project will begin development of the identified in the FY 1985-1986 study. Cost estimates for this project are Category II, Mature.

B. Project: 1955, Air Force Support to DOD Indications and Warning (I&W). This project provides I&W support to the Strategic Air Command (SAC), Air Force Space Command and Military Airlift Command Intelligence Centers. These centers are part of the Department of Defense coordinated I&W system.

This project will improve the current I&W system used by these commands by making advances in data handling, message processing and dissemination, data correlation/fusion techniques and decision aids. These advances will allow the I&W centers to deal with the growing threat into the late 80's and early 90's. This project will also enhance other I&W centers by developing transferable capabilities and advancing intelligence communications between all I&W centers. Improvements are performed in an evolutionary manner based on dynamic user requirements and worldwide threats. During FY 1986 the efforts at SAC continued the SAC Warning System Stage 1 development. The system architecture was defined, preliminary design reviews were held and subsystem specifications were begun. FY 1987 will see the installation of equipment and modification of facilities along with subsystem testing of the developed software. In FY 1988 formal test, acceptance and cutover will occur. This development will provide SAC with a

At Space Command, the Air Force Space Command Intelligence Upgrade (AIU) program was coded and tested at the subsystem level in FY 1986. During FY 1987 development will end and final test and acceptance will be performed by the government ending with cutover and operational use by mid-year. The AIU Follow-on Capability will also start in FY 1987 and will be at the system design phase by the end of the year. In FY 1988 the critical design will be developed and approved. FY 1989 will see coding and testing of the design and transition into the operational environment. In FY 1986, at HQ Military Airlift Command (MAC), the critical design was approved for the Military Airlift Intelligence System (MAIS) Block A; following this, the coding and testing was nearly completed. FY 1987 will hold the final test and acceptance of the system followed by cutover into an operational mode. Also in this year, the MAIS Block B contract will be awarded and will proceed to the preliminary design phase. In FY 1988 the critical design phase will be accomplished and coding of the system software will start. During FY 1989 the system will undergo testing, acceptance, and transition into an operational system. The MAIS Book B developments will provide MAC units and Special Operations Forces with that they encounter. Cost estimates for this project are Category II, Mature.

C. Project: 2053, Foreign Technology Division (FTD) Intelligence Processes. This project improves the FTD ability to acquire, evaluate, analyze and report on foreign scientific and technical information. New capabilities developed here will allow analysts to provide more timely and accurate threat assessments of foreign weapon systems. Several independent tasks are conducted simultaneously; as they are completed new tasks are initiated to satisfy outstanding, validated requirements. The project is managed at Rome Air Development Center where candidate tasks are reviewed with other intelligence related technology to insure there is no duplication of effort and to maximize

Program Element: #64750F — Title: Intelligence Equipment

DOD Mission Area: #327 - TIARA for Tactical Air Warfare — Budget Activity: #4 - Tactical Programs

technology sharing. Accomplishments in FY 1986 included the development and implementation of a model of a the demonstration of an expert system capable of . Also software to assist in were delivered.

In FY 1987 the project will deliver an In addition a functional description for integrating the various simulation systems at Foreign Technology Division (FTD) will be developed. Another task will develop a software package to assist in the analysis of weapons with a It will also create an expert system to aid in the analysis of In FY 1987, the program will also initiate a new effort which will extend the expert system for analyzing During FY 1988, the project will continue work on the deliver a functional description of a model, which can and deliver an analysis tool capable of It will also initiate a task to analyze In FY 1989 efforts will continue work on the application of artificial intelligence technology toward performing intelligence analysis, Cost estimates for this project are Category II, Mature.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64754F
DOD Mission Area: 343 - Theater Communications

Title: Joint Tactical Information Distribution System (JTIDS)
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		0	0	44,072	64,772	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The objective of this program is to develop a highly jam resistant, secure digital information distribution system for use in a tactical combat environment. The Joint Tactical Information Distribution System (JTIDS) is a joint development employing time division, multiple access, and spread spectrum techniques. The system will provide the connectivity and capacity to permit rapid and secure exchange of the essential command, control, and status information among all equipped elements in the tactical theater.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

Aircraft Procurement						
E-3 Class I Terminal Modification (PE 27417F)	0	0	0	N/A	0	79,500
E-3 Class 2/TADIL-J Modifiction (PE 27417F)	0	0	0	N/A	138,246	138,246
F-15 JTIDS Modification (PE 27130F)	0	33,200	39,300	N/A	99,400	171,900
Other Procurement						
Ground Terminals (PE 27434F)	0	0	0	N/A	0	91,862

* NOTE: Funding for FY 1986 and FY 1987 was contained in OSD PE 64771D.

EXPLANATION: (U) PROCUREMENT - In FY 1987, the JTIDS terminal procurement for the F-15 was reduced $1.5 million for the effects of Gramm-Rudman. The planned terminal procurement quantities were increased in FY 1988 and FY 1989 and deleted in FY 1990. This maintains the planned procurement of JTIDS for two wings of F-15s and accelerates the fielding of the F-15/JTIDS capability.

Program Element: 64754F
DOD Mission Area: 343 - Theater Communications

Title: Joint Tactical Information Distribution System (JTIDS)
Budget Activity: 4 - Tactical Programs

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Aircraft Procurement:						
E-3 (PE 27417F)						
Class 1 Terminal Modification						
Funds[1]	0	0	0	0	0	79,500
Quantities	0	0	0	0	0	34
Class 2/TADIL J Modification						
Funds[1]	0	0	0	0	138,246	138,246
Quantities	0	0	0	0	34	34
F-15 JTIDS Modification (PE 27130F)						
Funds[1]	0	25,800	58,000	59,500	0	143,300
Quantities	0	12[2]	72	76	0	160
Other Procurement:						
Ground Terminal (PE 27434F)						
Funds	0	0	0	0	0	91,862
Quantities	0	0	0	0	0	19

1 Funding is for aircraft modification kits. Does not include initial modification spares or communications security equipment for the F-15 modification kits.

2 Nine additional kits for flight simulators/maintenance trainer are included in the FY 1987 funding figure.

5. (U) RELATED ACTIVITIES: The JTIDS development is managed by a jointly manned program office. Development, prototype fabrication, and test of terminal equipments for various applications of the services will be funded under this program element and will be conducted in conjunction with the other programs with which the equipments will ultimately be integrated. Related Army, Navy, and OSD program elements are PE 64702A, PE 25604N, and PE 64771D, respectively.

6. (U) WORK PERFORMED BY: The Joint Program Office is located at the Electronic Systems Division, Hanscom AFB, MA. Work is also being done at the Aeronautical Systems Division, Wright-Patterson AFB, OH; and the Electromagnetic Compatibility Analysis Center, Annapolis, MD. The major contractors are Hughes Aircraft Company (Class 1 terminals), Fullerton, CA; Singer-Kearfott (Class 2 terminal full scale development (FSD)), Little Falls, NJ; International Business Machines (surface terminal facility), Owego, NY; McDonnell Douglas Aircraft Corporation (Class 2 terminal integration into the F-15), St Louis, MO; and MITRE Corporation (system engineering support), Bedford, MA.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: PE 64754F, Joint Tactical Information Distribution System (JTIDS)

A. (U) Project Description: Currently, information upon which to base critical operational decisions normally exists somewhere within a combat area, but may not always be available to the force element needing the data. Consequently, there is an urgent requirement for a system that will distribute essential information to all participating elements. The system must provide for a high volume of message traffic, work in a severe jamming environment, and prevent hostile forces from intercepting and using the transmitted information. The JTIDS satisfies these requirements. The system will be structured to operate as an information distribution network into which tactical users transmit command and control, surveillance, position and status, or other significant combat information at specific time intervals. All of this information is immediately available to each net participant who may select for either display or data base storage that portion of the information in which he/she is interested. The system will interconnect the E-3 aircraft, ground and shipboard command, control and surveillance centers, and combat and support aircraft. Beginning in FY 1988, funds are provided for the development of a follow-on JTIDS Class 2 compatible terminal called the Multifunctional Information Distribution System (MIDS). This new program is an OSD directed, NATO cooperative effort to develop advanced terminals for space constrained US and NATO fighter aircraft such as the USAF F-16. This program will extend the JTIDS capability throughout the tactical forces for both the US and NATO.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Continued full scale development of the Class 2 terminal and conducted development flight and ground tests in five F-15 fighter aircraft. Continued development of a high-powered version of the Class 2 terminal for the E-3 and Modular Control Element (MCE) and continued development activities leading toward the incorporation of the Tactical Digital Information Link "J" (TADIL-J) message standard into these systems. Continued development of F-15 and MCE test support assets required for compatibility and interoperability testing with the other Services. Testing to obtain frequency support for higher operation transmission duty factors was conducted. Follow-on technology investigations were conducted. Began Initial Operational Test and Evaluation (IOT&E) of the Class 2 terminal in the F-15. All funds for these efforts were contained in OSD PE 64771D.

(2) (U) FY 1987 Program: OSD PE 64771D contains the funding for completion of the Class 2 terminal development, completion of the Class I terminal support equipment development, and completion of the IOT&E of the Class 2 terminal in the F-15. The OSD PE funds the continuing development of a high powered version of the Class 2 terminal for the E-3 and the MCE and begins development of unique F-15 JTIDS support equipment. The OSD funded program also provides for the expansion of the TADIL-J message standard incorporated in the Class 2 terminal and continues TADIL-J development and TADIL-J test preparation for the E-3, F-15 and MCE. Additionally, test planning and support for joint service TADIL-J development certification testing, and specialized testing and analysis in support of frequency clearance authorizations will be accomplished.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Continues software development for the F-15 and MCE integration efforts. Begins full scale development of a follow-on Class 2 compatible terminal. This development is a NATO cooperative effort for a Multifunctional Information Distribution System (MIDS) which will be integrated into both US and NATO fighter aircraft. Funding for this effort will be shared by the participating countries with the US taking the lead in the development. The estimates are in the mature, budgetary, and planning categories (Confidence Levels II, III and IV).

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Continues software development and integration efforts for the F-15 and MCE. Continues full scale development of the MIDS Class 2 terminal. Begins follow-on test and evaluation efforts for the F-15 Class 2 terminal. Begins development testing of the MCE/JTIDS system. The estimates are in the budgetary and planning categories (Confidence Levels III and IV).

(5) (U) Program to Completion: This is a continuing program. Funds are provided for the integration of the JTIDS Class 2 terminal into the F-15 and MCE and for the US share of the full scale development of the MIDS Class 2 compatible terminal.

C. (U) Major Milestones:

		Milestones		Dates
(1)	(U)	Waveform decision		February 1976
(2)	(U)	Initial E-3 Prototype Terminal Delivery		June 1977
(3)	(U)	Start Surface Terminal Development		June 1977
(4)	(U)	Start E-3 (Class 1) Terminal Low-rate Initial Production		July 1980
(5)	(U)	Start Fighter Terminal (Class 2) Full Scale Development		January 1981
(6)	(U)	Surface Terminal Long-lead Production Decision		December 1981
(7)	(U)	First Production Delivery of Class 1 (E-3) Terminal		June 1982
(8)	(U)	First Surface Terminal Production Delivery		September 1984
(9)	(U)	Development Test/Initial Opertional Test and Evaluation (IOT&E) of F-15 Class 2 Terminal Complete	*(December 1986)	March 1987

Milestones		Dates
(10) (U) Class 2 Terminal Production Decision	*(March 1987)	June 1987
(11) (U) First Class 2 Production Terminal Delivery		June 1989

(U) Explanation of Milestone Changes:

(9) and (10) (U) Completion of IOT&E and the Class 2 terminal production decision has been delayed three months due to technical problems which have now been resolved.

* Dates presented in DOD FY 1987 Descriptive Summary (PE 64771D)

9. (U) COOPERATIVE AGREEMENTS: The Office of the Secretary of Defense is sponsoring, under the Nunn Amendment legislation, the Multifunctional Information Distribution System (MIDS) NATO cooperative development project. This agreement is expected to be signed in November 1986 between the US, UK, Germany, Italy, Norway, France, and Canada. The agreement calls for the development of a smaller, low cost, Class 2 compatible terminal that can be produced to the maximum extent practical by the participating nations. The MIDS terminal cooperative development program will be structured in two phases. Phase I will be a project definition phase, and Phase II will be a Full Scale Development (FSD) phase. Singer-Kearfott is the lead US contractor for Phase I. Phase II contractors are TBD. Financial commitments of the participating nations is set at a minimum of $500,000 each for the Phase I effort which is scheduled to begin in January 1987. Additionally, the US and UK entered into an agreement in September 1983, for the UK's development and acquisition of JTIDS equipment, the US and UK common requirement for an interoperable system, and the common objective to encourage the acceptance of JTIDS within NATO in the interest of NATO wide interoperability. The UK has based its JTIDS Full Scale Development Program on the US Class 2 Time Division Multiple Access terminal planned for incorporation into US F-15 aircraft. The agreement covers bilateral understandings associated with this equipment and technology. The UK Class 2 development is intended for the Tornado aircraft and is nearing completion.

Budget Activity: 4, Tactical Programs
Program Element: 64754F, Joint Tactical Information Distribution System

Test and Evaluation Data

1. (U) Development Test and Evaluation (DT&E): The Joint Tactical Information Distribution (JTIDS) program is developing a highly jam-resistant, secure digital information distribution system for use in a tactical combat environment. This joint development effort, managed by the Air Force Systems Command Electronic Systems Division at Hanscom AFB, Massachusetts is a merger of the earlier efforts of Air Force (SEEK BUS) and Navy development programs.

(U) The feasibility of Time Division Multiple Access (TDMA) was demonstrated during the March 1973 E-3A brassboard flight test. Future tests will occur throughout the development cycle of each class of terminal.

(U) Contractor flight tests of the Hughes Class 1 Advanced Development Model terminal on the E-3A aircraft evaluated net entry, synchronization, operation, and jamming margin. All specific operating parameters of the Class 1 terminal were met or exceeded in test programs in 1977 and 1978, but net management was assessed as time consuming. Since that time, a new net management time-slot assignment algorithm has been developed. Additional testing of the Class 1 full scale development model took place in September and October 1981.

(U) Additional testing in 1979 of the multi-path propagation and doppler shift did not cause any degradation with the JTIDS terminal in the full anti-jam mode. Performance specifications were met under jamming conditions.

(U) During development flight tests at Eglin Air Force Base from November 1979 through October 1980, the Class 1 terminal was interfaced with the existing Tactical Air Control System through the Adaptable Surface Interface Terminal. Functional performance was successful, but reliability of the Class 1 terminal was below expectations. Further testing of Class 1 terminal reliability was accomplished during the September-October 1981 tests. The reliability during these tests was improved and overall suitability was rated satisfactory.

(U) Contractor acceptance testing of the Singer-Kearfott advanced development of a Class 2 terminal was completed late in 1978. The Naval Air Development Center completed bench and flight testing of this terminal in September 1979. Some net management, relative navigation, anti-jam, and Tactical Air Navigation (TACAN) system operations were deficient. Further testing was conducted during the pod-configured Class 2 Advanced Development Model tests from June 1981 to January 1982. The objective of packaging the JTIDS functions in a fighter-sized terminal was met successfully.

(U) DT&E of the Class 2 Terminal began with AF and Army bench and field testing in October 1985. The first DT&E flight test occurred in March 1986 on a modified F-15A at Eglin AFB, FL. Air Force DT&E flight testing ended in October 1986 with the verification of final software improvements for the dedicated IOT&E flight test phase. DT&E flight testing included demonstration and evaluation of Class 2 Terminal functions and features relating to tactical information communication (displayed data/voice), electronic warfare, relative navigation, EMC, TDMA net management, human factors, BIT, reliability, safety, interoperability between Class 1 and Class 2 Terminals, and counter-air applications between Army Air Defense assets and F-15 aircraft. Certification of the AF Class 2 Terminal for dedicated AF IOT&E is expected in November 1986. Joint Army and Air Force IOT&E testing is planned to begin in March 1987.

(U) The Army requirement for JTIDS Class 2 Terminals is for employment within the PLRS/JTIDS Hybrid (PJH) system and supports NATO, Joint, and Army interoperability. Because the PJH is an evolving system, the Army decided to conduct testing in phases. Army objectives for the joint IOT&E include exercising the terminal in a multi-service, field representative environment, and measuring the terminal's technical characteristics. Interfaces with select Army host systems are being evaluated. Results of this testing will support an initial production of JTIDS terminals for the continued development of the PJH.

(U) The Navy's Class 2 Terminal DT&E is limited to an early assessment of the terminal's potential to satisfy Navy operational requirements. The Navy will use the existing AF and Army test objectives, which relate to Navy requirements, to conduct this assessment.

(U) An extensive flight and bench test program to demonstrate compatibility with air traffic control equipment operating in the same portion of the frequency spectrum was conducted under the auspices of the National Telecommunications and Information Administration (NTIA) in conjunction with the Federal Aviation Administration (FAA). These tests demonstrated that JTIDS can co-exist with other systems in the band without harmful interference, and resulted in a frequency allocation for JTIDS TDMA generally referred to as the 40/20 allocation. The conditions for JTIDS spectrum support are described in the FAA document 21167 which allows JTIDS terminals to operate without additional coordination with the FAA or NTIA. Operation outside the uncoordinated limits require coordination and an assignment by the Frequency Assignment Subcommittee (FAS) on a case-by-case basis.

(U) Further joint Electromagnetic Compatibility testing (EMC) is underway to allow for the increased operation of JTIDS TDMA at a 100/50 Time Slot Duty Factor level. These tests will continue through 1988 with the first phase structured to a support the JTIDS Class 2 production decision in June 1987.

(U) Electromagnetic Compatibility testing has been accomplished in the United Kingdom (UK) and Germany to support frequency clearance for JTIDS TDMA in Europe. Based on this testing NATO has granted frequency clearance for the 100/50 Time Slot Duty Factor (TSDF) level. The current NATO clearance is only for 18 airborne NATO Airborne Early Warning Systems and 32 associated ground sites. The UK is currently considering relaxing some of the associated restrictions to allow for expanded JTIDS operations.

2. (U) Operational Test and Evaluation (OT&E): The purpose of JTIDS initial operational test and evaluation (IOT&E) is to evaluate the operational effectiveness and operational suitability of JTIDS terminals and the ability of the system to support both individual and joint service concepts in an operational environment. Testing of JTIDS has included multi-service (Army, Navy, Air Force, and Marine Corps) combined development test and evaluation (DT&E)/IOT&E and service-unique testing. The Air Force Operational Test and Evaluation Center (AFOTEC) conducts IOT&E for the Air Force and is the lead agency for multi-service IOT&E. The other service operational test and evaluation organizations involved in JTIDS testing are the United States Army Operational Test and Evaluation Agency (USAOTEA), the Navy Operational Test and Evaluation Force (OPTEVFOR), and the Marine Corps Operational Test and Evaluation Agency (MCOTEA).

(U) Test and Production Milestones:

E-3A/JTIDS advanced development model (ADM) terminal DT&E/IOT&E	May-Jun 78
Adaptable Surface Interface Terminal (ASIT) full-scale development (FSD) terminal DT&E/IOT&E	Nov 79-Dec 80
ASIT operational suitability evaluation	May-Dec 81
JTIDS Class 2 pod-configured ADM terminal IOT&E	Jun 81-Jan 82
US/NATO E-3A IOT&E	Sep-Oct 81
ASIT long-lead production decision	Dec 81
Class 2 (fighter) FSD TDMA terminal/F-15 DT&E	Oct 85-Nov 86
Class 2 (fighter) FSD TDMA terminal/F-15 IOT&E	Aug 86-Apr 87
ASIT follow-on operational test and evaluation (FOT&E)	Nov 86-Apr 87
Class 2 TDMA terminal production decision	Jun 87
Class 2 production TDMA terminal/F-15 integration FOT&E	1987-1990 time frame

An IOT&E of a TDMA JTIDS Class 1 ADM terminal installed in an E-3A was conducted during May-Jun 1978 by AFOTEC. Major emphasis was placed on assessing the resistance of JTIDS to electronic countermeasures (ECM). The test demonstrated a and the potential to greatly enhance digital information distribution. Problems associated with the establishment of the JTIDS net and net operations were identified during testing. The operational suitability could not be conclusively determined due to reliance on the contractor for system maintenance and support, the limited test period, and the small number of failures. AFOTEC

recommended that further operational suitability testing of the JTIDS Class 1 terminal be conducted. The results of the E-3A/JTIDS IOT&E were reported in the AFOTEC E-3A Joint Tactical Information Distribution System (JTIDS) Terminal IOT&E Final Report (U), December 1978, SECRET.

Additional DT&E/IOT&E of JTIDS in the E-3A was conducted between 15 September and 30 October 1981, using a pre-production Class 1 terminal. Eighteen sorties were flown. The test included the use of three ASITs interfaced with both Army and Air Force ground command and control facilities. It was determined that the addition of JTIDS

However, it was determined that

Because the Class 1 terminal failed to meet the adjusted mean time between maintenance threshold, terminal reliability was rated deficient. The Air Force Operational Test and Evaluation Center published the results of this test in an evaluation report titled US/NATO E-3A Initial Operational Test and Evaluation Final Report (U), March 1982, SECRET.

(U) The ASIT provides a transparent interface between JTIDS-equipped systems (such as the E-3A) and existing command and control systems which use Tactical Digital Information Link B (TADIL-B). The ASIT consists of two principal subsystems. The first is a translator-processor (computer) which converts existing Tactical Air Control System/Tactical Air Defense System (TACS/TADS) messages passed over TADIL-B into JTIDS equivalent messages and vice versa. The second subsystem is the JTIDS Class 1 terminal which performs a signal transmission, reception, and related digital processing of the JTIDS signal.

(U) An IOT&E of three ASITs was conducted by AFOTEC, assisted by the Army and Marine Corps test organizations, in a multi-service combined DT&E/IOT&E at Eglin AFB, Florida, from November 1979 to December 1980. Principle units/facilities to which the ASIT was interfaced were an Air Force Message Processing Center, an Air Force Control and Reporting Center, an Air National Guard Control and Reporting Post, an Army AN/TSQ-73 Air Defense Command and Control System, and a Marine Corps Tactical Air Operations Center. The ASIT IOT&E confirmed the findings of the 1978 E-3A/JTIDS ADM terminal IOT&E that JTIDS provides an ECM-resistant data link between the E-3A and ground command and control elements. The test also demonstrated that JTIDS provided solid data-link communications that were relatively easy to establish and maintain. Although maintenance was performed exclusively by contractor personnel with military personnel being limited to over-the-shoulder observation, overall operational suitability was found to be deficient. This was due to the low reliability of the JTIDS Class 1 terminal. Test results are documented in the Joint Tactical Distribution System (JTIDS) Adaptable Surface Interface Terminal IOT&E Air Force Evaluation Report (U), March 1981, SECRET.

(U) A continuation of the operational suitability portion of the ASIT IOT&E was conducted by AFOTEC during May-December 1981. During the evaluation, the ASIT equipment (less the Class 1 terminal) was maintained by Air Force technicians. Because technical data and support equipment were not available for the Class 1 terminal, it was contractor maintained. The reliability of the Class 1 terminal demonstrated significant improvement over the results obtained during the original ASIT IOT&E, and overall suitability was found to be satisfactory. AFOTEC recommended an FOT&E be conducted on an ASIT production terminal to assess the impact of the major programmed changes in the terminal. The FOT&E is planned from November 1986 to April 1987 at Eglin AFB, Florida. The FOT&E will be divided into two

separate stages. First will be a period of reliability, availability, and maintainability (RAM) data collection which will begin with the turnover of the two ASITs to the 727 Tactical Control Squadron (test) and 728th Tactical Control Squadron. The second and most comprehensive stage will the testing conducted during a portion of the Class 2 IOT&E from November 1986 to April 1987. Test results of the suitability evaluation are documented in the Joint Tactical Information Distribution System (JTIDS) Adaptable Surface Interface Terminal Suitability Evaluation Final Report, March 1982.

(U) A preliminary evaluation of JTIDS implementation in fighter aircraft was conducted between June 1981 and January 1982. A Singer-Kearfott AN/URQ-28 ADM JTIDS terminal and associated support equipment were installed in an AN/ALQ-76 pod which is designed for use on Maverick-capable aircraft and makes use of existing controls, displays, and pylon interfaces. The pod was primarily designed to give early hands-on fighter experience with JTIDS. Three each pods were flown on F-4 and A-10 aircraft to evaluate the contribution of JTIDS in defensive counterair, close air support, and air interdiction mission roles. Fifteen JTIDS missions were flown during the test. The terminal demonstrated the potential to enhance mission effectiveness of fighter aircraft in the conduct of all three of these mission areas. Tactical situation awareness was improved through the use of JTIDS with a corresponding reduction in the need for voice communication. The JTIDS display provided the fighter crews with the same general air picture that was available to the weapons controller in either surface or airborne command and control units. The enhanced situation awareness provided to the aircrews of the fighter aircraft reduced the requirements for voice commands, attack vectors, and threat warnings. This, in turn, reduced the weapons controller workload. However, since the usefulness of the JTIDS-display is primarily dependant upon the timeliness and accuracy of the information provided to the net, accurate tracking of hostile aircraft becomes essential. This requirement tended to increase the surveillance operator workload when the autotracking feature of the TACS was degraded. Operational suitability was not evaluated during the test because there are no plans to produce a JTIDS terminal in a pod configuration. The test results were published in a test report titled Joint Tactical Information Distribution System (JTIDS) Class 2 Advanced Development Model Terminal (Pod Configuration) Initial Operational Test and Evaluation Final Report (U), April 1982, CONFIDENTIAL.

(U) The initial operational test and evaluation (IOT&E) of the JTIDS Class 2 full-scale development terminal is being conducted to determine the improvement in operational effectiveness and suitability caused by incorporating the JTIDS Class 2 terminal in selected Air Defense Units. Class 2 FSD terminals have been installed in a temporary configuration on three F-15A aircraft and several Army air defense elements. In addition, the Class 2 have been installed in a production-like modification in two F-15C multi-staged improvement program (MSIP) aircraft. This is an independent multi-service IOT&E program managed by AFOTEC.

(U) Activity in the JTIDS Class 2 IOT&E has been limited to man-in-the-loop simulation testing at the McAir F-15 combat simulator in St. Louis, Missouri. This testing was conducted from 12 August through 25 September 1986. The simulator was used to gather sufficient data to complete a statistical comparison of F-15 mission performance with and without JTIDS to determine operational utility of JTIDS. The simulation missions were limited to scenarios with no more than two manned "friendly" F-15s versus up to eight adversary aircraft. A total of 240 defensive counterair simulator missions were flown.

(U) The flight test segment of IOT&E is being conducted at both the Eglin AFB and Tyndall AFB ranges. This segment provides the data for the suitability evaluation and employment. The flight test is being conducted in three phases: shakedown, multi-service, and targeting efficiency. TAC personnel are being employed to both operate and maintain the JTIDS Class 2 terminal. The Army is expected to employ portions of the 11th Air Defense Artillery Brigade in the multi-service portion of the these tests.

(U) No assessment or quick look reports for this IOT&E have been published. Data from the simulator is being analyzed and will be included in the final report on the JTIDS Class 2 IOT&E. This report is scheduled to be published in June 1987.

(U) AFOTEC Test Reports on JTIDS are summarized below:

(1) (U) E-3A Joint Tactical Information Distribution System (JTIDS) Terminal IOT&E Final R Report (U), December 1978, SECRET.

(2) (U) Joint Tactical Information Distribution System (JTIDS) Adaptable Surface Interface Terminal IOT&E Air Force Evaluation Report (U), March 1981, SECRET.

(3) (U) US/NATO E-3A Initial Operational Test and Evaluation Final Report (U), March 1982, SECRET.

(4) (U) Joint Tactical Information Distribution System (JTIDS) Class 2 Advanced Development Model Terminal (Pod Configuration) Initial Operational Test and Evaluation Final Report, March 1982.

(5) (U) Joint Tactical Information Distribution System (JTIDS) Class 2 Advanced Development Model Terminal (Pod Configuration) Initial Operational Test and Evaluation Final Report (U), April 1982, CONFIDENTIAL.

3. System Characteristics:

Characteristic	Objective	Demonstrated to Date
Frequency	960-1215 megahertz	960-1215 megahertz
Range	300 nautical miles (1200 nautical miles with relay)	300 nautical miles
Capacity	57.6 kilobits per second	57.6 kilobits per second
Users	2-2000	9
Message Error Rate	10-2	10-2
Anti-Jam Margin		
Range Accuracy		

(U) Demonstrations of system characteristics are reported in the following test reports:

1. (U) E-3A Joint Tactical Information Distribution System (JTIDS) Initial Operational Test and Evaluation Final Report (U), December 1978, SECRET, Air Force Test and Evaluation Center, Kirtland Air Force Base, New Mexico 87117.

2. (U) Joint Tactical Information Distribution System (JTIDS) Adaptable Surface Interface Terminal Initial Operational Test and Evaluation Report (U), March 1981, SECRET, Air Force Test and Evaluation Center, Kirtland Air Force Base, New Mexico 87117.

3. (U) Joint Tactical Information Distribution System (JTIDS) Class 2 Advanced Development Model Terminel (Pod Configuration) Initial Operational Test and Evaluation (IOT&E) Final Report (U), April 1982, CONFIDENTIAL, Air Force Test and Evaluation Center, Kirtland Air Force Base, New Mexico 87117.

4. (U) Current Test and Evaluation:

a. (U) T&E activity (past 12 months):

Event	Planned Date	Actual Date	Remarks
DT&E	Oct 85 - Apr 86	Oct 85 - Oct 86	End of DT delayed to correct software deficiencies
IOT&E McAir SIM	May 86 - Jun 86	Aug 86 - Sep 86	Start of SIM delayed due to simulator problems

b. (U) Planned T&E Activity (next 12 months):

Event	Scheduled Date	Remarks
IOT&E Flight Test	Oct 86 - Feb 87	Air Force's only flight test of F-15 JTIDS system
ASIT FOT&E	Nov 86 - Apr 87	FOT&E of ASIT system conducted with IOT&E
Multi-service	Feb - Apr 87	Multi-service test of JTIDS system

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64756F Title: Side Looking Airborne Radar (SLAR)
DOD Mission Area: 327 - TIARA for Tactical Air Warfare Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	18,778	18,726	11,117	5,254	Continuing	N/A
2037	SLAR Sensors	500	5,885	317	3,789	Continuing	N/A
2451	SLAR Exploitation	18,278	12,841	10,800	1,465	Continuing	N/A

2. DESCRIPTION OF ELEMENT AND MISSION NEED: This program develops advanced high resolution SLAR components and systems capable of collecting radar imagery of ground targets from an airborne platform, followed by transmission, processing, and exploitation of the processed imagery to yield reconnaissance and strike information during day or night, and adverse weather conditions. Near-real-time SLAR imagery exploitation is performed in a ground station to achieve high resolution detection and to provide for of the radar sensor. The platform and ground stations are procurred in P.E. 27215F. Imagery-derived fixed target location reports are then sent to theater users including battlefield command centers, intelligence centers such as the Combat Operations Intelligence Centers in Germany and Korea, and strike systems such as the Joint Surveillance Target Attack Radar System (Joint STARS).

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	23,440	19,691	19,278	N/A	Continuing	N/A
Aircraft Procurement (PE 27215F)	25,000	27,000	0	N/A	8,100	213,900
Other Procurement (PE 27215F)	10,103	0	43,724	N/A	105,049	198,876

EXPLANATION: (U) The FY 1986 decrease is due to Gramm-Rudman-Hollings reductions ($1.038) and reprograming to higher priority requirements ($3.3). The FY 1988 reduction resulted from Air Force program changes.

Program Element: 64756F Title: Side Looking Airborne Radar (SLAR)
DOD Mission Area: 327 - TIARA for Tactical Air Warfare Budget Activity: 4 - Tactical Programs

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Aircraft Procurement/ (ASARS-II) PE 27215F: *	28,500	27,000	0	4,600	3,500	63,600
Other Procurement/(Ground Station) PE 27215F						
Funds	13,679	1,691	7,361	11,234	76,395	110,360
Quantities **					1	
Military Construction:						
Funds	18,375	8,930	0	8,500	22,338	58,143

* In FY 1989, aircraft procurement buys the depot level maintenance necessary to support production radar repair. This will reduce support costs, decrease repair time, and increase operational radar availability.

** FY 1988 funds procure support equipment for the first TR-1 ground station radar processor procured in FY 1985, plus changes to government funded equipment to permit installation in a fixed ground station instead of a transportable facility.

5. (U) RELATED ACTIVITIES: PE 63208F, Advanced Electronics for Aerospace Vehicles, is performing advanced development efforts in foliage penetration radar techniques. PE 63260F, Intelligence Advanced Development, is developing advanced techniques for managing tactical reconnaissance information. Exploited Side Looking Airborne Radar (SLAR) data will be an input to this system. PE 27215F, TR-1 Squadrons, procures operational Advanced Synthetic Aperture Radar System (ASARS-2) SLAR sensors and ground stations, and beginning with FY 1987, assumed development responsibility for common mission support elements in the TR-1 ground station. PE 27217F, Tactical Air Reconnaissance System, is fielding a system to upgrade the RF-4C and plans to incorporate a radar system for a day/night and adverse weather imaging capability in late 1990's.

6. (U) WORK PERFORMED BY: This program is managed by the Tactical Reconnaissance System Program Office, Aeronautical Systems Division, Wright-Patterson AFB, OH. Contractors: Hughes Aircraft Corp, Culver City, CA, develops the ASARS-2 and ASARS Processing Segment; Ford Aerospace, Palo Alto, CA, developed the prototype Tactical Reconnaissance Exploitation Demonstration System and is the prime contractor for the production TR-1 Ground Station.

Program Element: 64756F
DOD Mission Area: 327 - TIARA for Tactical Air Warfare

Title: Side Looking Airborne Radar (SLAR)
Budget Activity: 4 - Tactical Programs

7. (U) PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

Project: 2037, SLAR Sensors: This project develops improvements for the Advanced Synthetic Aperture Radar System (ASARS-2), ASARS Processing Segment (APS), and Electronically Steerable Antenna (ESA). The radar system provides a unique capability to penetrate clouds and other adverse atmospheric conditions in daylight or at night, operates at ranges beyond defensive threats, and provides accurate location and other intelligence about targets under conditions in which non-radar sensors are ineffective. The sensor has a search mode which produces up to a [ ], and two spot modes which produce a [ ]. The ESA antenna will scan up to [ ] of radar modes and/or search areas. Peacetime Aerial Reconnaissance Program missions continued in FY 1986 and a highly successful extended range test was conducted in the spotlight mode. Work will begin in FY 1987 to implement software and hardware changes necessary to incorporate the extended range in search mode from the current [ ]. An effort to achieve imagery yield at extended ranges equal to that which was specified at the [ ] will be implemented. In FY 1988 through FY 1992, an effort to [ ] will also be initiated. A series of flight tests are planned in conjunction with this effort. A study will be initiated in FY 1991 to assess the design of a podded SLAR to be employed on a tactical reconnaissance aircraft which will lead to flight demonstration in the early 1990s. A preplanned product improvement will then be incorporated into tactical reconnaissance aircraft for an upgraded day/night and adverse weather imaging capability.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2451, SLAR Exploitation

A. Project Description: The development of the image exploitation and data handling segment for the ASARS-2 radar is this project's highest priority. This effort develops and tests SLAR exploitation components and systems associated with the TR-1 Ground Station (TRIGS). Operational requirements include near-real-time processing and exploitation to achieve reliable detection, location, [ ] of fixed or mobile tactical sized targets (Surface-to-Air Missiles, trucks, tanks, etc.) over a wide area. To meet these requirements, advanced digital exploitation techniques will be used to enable a radar image interpreter to identify and exploit targets on a display screen. This exploitation system will remedy the lack of a near-real-time image exploitation capability in current operational SLAR systems, and will improve the timeliness of target reporting (less than [ ]) New production micro-circuits will be integrated into the production APS. The ASARS-2 radar is the operational sensor producing radar imagery to be exploited by equipments developed in this line.

Program Element: 64756F	Title: Side Looking Airborne Radar (SLAR)
DOD Mission Area: 327 - TIARA for Tactical Air Warfare	Budget Activity: 4 - Tactical Programs

B. (U) Program Accomplishments and Future Efforts:

(1) FY 1986 Accomplishments: The TR-1 Ground Station (TRIGS) system design review was held in May. A test of the Tactical Reconnaissance Exploitation Demonstration System (TREDS) performance with the Advanced Synthetic Aperature Radar (ASARS-2) operating at was completed in August. The development and test of TRIGS operational software will benefit from this effort. Software packages were written in preparation for FY 1987 and 1988 insertion into ASARS Processing Segment (APS) as it is being built and tested. TRIGS facility design began in preparation for the application of NATO funding for the ground site.

(2) FY 1987 Program: The first ASARS-2 production radar entered flight test in June and was accepted in November. Work will begin to implement software and hardware changes necessary to incorporate the extended range in search mode from the current An effort to achieve imagery yield at extended ranges equal to that which was specified at the original maximum range of will be implemented. Testing of individual TRIGS elements and subelements will begin. TRIGS preliminary design review is scheduled for the third quarter. Site preparation activities will also begin.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: APS testing will begin as hardware subcomponents are assembled. Planning for system level testing will continue. Logistics development will continue with support equipment software writing. TRIGS critical design review is scheduled. The funding levels are Category III budgetary estimates.

(4) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: System level integration will begin at the contractor's plant, bringing together the APS, the radar imagery exploitation segment, the mission control segment, and the communications and support segments. Initial cadre training will begin. and an effort to will also be initiated. A series of flight tests are planned in conjunction with this effort. The funding levels are Category III budgetary estimates.

(5) Program to Completion: This is a continuing program. installed in the hardened bunker, and an initial operational capability (IOC) will be achieved by In FY early 1991, the Tactical Reconnaissance Exploitation Demonstration System (TREDS) will be deactivated and some of its equipments will be refurbished for use in the northern TR-1 Ground Site (TRIGS-2). and is the final element in establishing a full operational capability in Europe for the TR-1 Tactical Reconnaissance System.

C. (U) Major Milestones:

		Milestone	Dates
(1)	(U)	Tactiacal Reconnaissance Exploitation Demonstration System (TREDS) and Advanced Synthetic Aperature Radar (ASARS-2) Prototype Delivery to Europe	June 1985
(2)	(U)	ASARS-2 First Production Radar Accepted	November 1986
(3)	(U)	TR-1 Ground Station (TRIGS) Element Level Testing begins	August 1988
(4)	(U)	TRIGS System Level Testing begings	September 1989
(5)	( )	TRIGS Overseas Deployment begins	
(6)	( )	TRIGS Initial Operational Capability (IOC)	
(7)	( )	TRIGS-2 IOC	

* Date not shown in FY 1987 Descriptive Summary

(U) Explanation of Milestone Changes

(7) (U) TRIGS-2 Full Operational Capability slipped two years due to the decision to provide a second ground station with full capability instead of a hardened prototype. This change fully meets the theater requirement for TR-1 ground stations.

9. (U) Cooperative Agreements: None

Budget Activity: 4, Tactical Programs
Program Element: 64756F, Side Looking Airborne Radar (SLAR)

Test and Evaluation Data

1. (U) Development Test and Evaluation (DT&E): The SLAR system development is based upon a building block approach to providing a Tactical Reconnaissance System. The TR-1 Reconnaissance System (TRS) acquisition is a follow-on to the U-2R. Test and evaluation plans and reports of completed evaluations are documented in special access programs and will be made available to appropriately cleared personnel. Tests on the Advanced Synthetic Aperture Radar System (ASARS) sensor began in fiscal year 1981. Tests on the ground processing and exploitation station were completed in first quarter fiscal year 1986.

(U) The ASARS II development effort consists of two major projects managed by the Aeronautical Systems Division. One of these projects is with the Hughes Aircraft Corporation for development of an airborne sensor and a radar ground processor. The second project involves design of a ground facility to exploit ASARS imagery. Multiple program requirements are being addressed in these projects to meet the need for strategic/national and tactical SLAR collection, processing, timely exploitation and reporting during peace, crisis and war. Specific system requirements for the U-2R, and tests conducted on the U-2R, apply directly to the follow-on procurement of the Advanced Synthetic Aperture Radar System airborne and ground elements for the TR-1. These tests are documented in the Descriptive Summary for Program Element 64756F.

2. (U) Operational Test and Evaluation (OT&E): An OT&E of projects being developed within this program, which concern the TR-1 Reconnaissance System, will be conducted in conjunction with the TR-1 Reconnaissance System OT&E. The purpose of this OT&E is to evaluate the aggregate system capability to provide near-real-time intelligence information to tactical commanders. See the TR-1 Squadron Congressional Data Sheet Program Element 27215F, Budget Activity #4 - Other Aircraft for detailed information. Air Force Operational Test and Evaluation Center (AFOTEC) has no other test responsibility under this program element.

3. (U) Systems Characteristics:

(U) ADVANCED SYNTHETIC APERTURE RADAR SYSTEM (ASARS):

(U) Characteristic	Objective/Threshold	Demonstrated
Search Mode	[	[
Range		
Swath Width		
Squint Angle		
Resolution	]	]

Budget Activity: 4, Tactical Programs
Program Element: 64756F, Side Looking Airborne Radar (SLAR)

(U) Characteristic	Objective/Threshold	Demonstrated
Spotlight Mode		
Range		
Spot Size		
Squint Angle		
Resolution		

* These numbers represent the practical maximum range capability of ASARS II for image exploitation purposes per TREDS Director message 250730Z Jul 86. However, the radar has produced imagery in search mode at

** was not specified by the AF, but was set as a goal for the contractor.

(U) TR-1 AIRCRAFT: All required operational characteristics verified by over 10 years of U-2R operation. Procurement organization will perform routine acceptance flight tests on each aircraft prior to delivery.

4. (U) Current Test and Evaluation (T&E):

T&E Activity (Past 12 Months)

Event	Planned Date	Actual Date	Remarks
(U) Dedicated Overseas IOT&E	16 June-19 December 1986	In progress	IOT&E in progress

T&E Activity (Next 12 Months)

Event	Planned Date	Remarks
(U) Production ASARS II Radar Deploys to Europe	January 1987	

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64770F
DOD Mission Area: 217 - Land Warfare Surveillance & Reconnaissance

Title: Joint Surveillance Target Attack Radar System (Joint STARS)
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		156,541	300,000	337,912	238,296	195,325	1,381,574

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: A critical need exists for an effective capability to delay, disrupt, and destroy first and second echelon Warsaw Pact armored forces and to hamper attempts to break through Allied positions. Also, there is a critical need for a rapidly deployable capability for use in less intense conflicts in contingency areas. To meet these needs, the Air Force and Army initiated the Joint Surveillance Target Attack Radar System (Joint STARS) with the Air Force as lead Service. Joint STARS will provide information to delay/disrupt/destroy mobile targets in the enemy second echelon. Joint STARS is unique because it is a closed loop system for real time detection, tracking, and attack of enemy ground moving targets. Using moving target indicator and synthetic aperture radar techniques, Joint STARS can detect and track enemy forces. Joint STARS integrates the accurate attack of those forces by providing position updates and exact enemy locations to direct attack aircraft, artillery, and standoff missiles. The Army Corps commander requires wide area surveillance information to understand enemy force build-up and scheme-of-maneuver in order to apply effective and timely maneuver of forces, battlefield management, and targeting of tube artillery, multiple launch rocket systems and tactical missiles.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	173,047	355,692	335,516	N/A	298,735	1,422,500

EXPLANATION: (U) The FY 1986 decrease reflects the Gramm-Rudmann-Hollings reduction. This reduction resulted in the postponement of critical change orders from FY 1986 to FY 1987. The FY 1987 Congressional reduction ($55.7 million) will result in delays in implementing the mandatory Ada software language and initiation of the third E-8A RDT&E aircraft. Both PE 63770F and PE 64770D funding are included in FY 1986. The increase in FY 88 is due to initiation of E-8A self

defense suite efforts. The Total Estimated Cost in paragraph 3 differs from the $1,206 million stated in the FY 1987 Descriptive Summary. The total provided in last year's document included only the FY 1985-1991 funding in PEs 64770F and 64770D. The higher figure portrayed here is consistent with the 31 December 1985 Selected Acquisition Report and includes total program costs from FY 1982 through completion, including PEs 63770F, 64616F, 64770F and 64770D.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable

5. (U) RELATED ACTIVITIES: This program element is closely coupled to the Joint STARS NATO Cooperative Development Project (PE 63790F, Project 3639), the Army RDT&E Joint STARS program in PE 64770A and the Army Joint STARS Ground Station Module (GSM) procurement in the Army Other Procurement program. Program element 63770F, Joint STARS Advanced Development, provided risk reduction and performance improvement for target detection, accuracy, electronic counter-countermeasures and target discrimination. No funding was requested beyond FY 1986 for PE 63770F. PEs 63770F and 64770F/64770D replaced "PAVE MOVER" (PE 63747F) and the "PAVE MOVER Engagement System" (PE 64616F). In May 1982 OSD designated the Air Force as the lead Service and identified the Service's responsibilities for the Joint STARS program. The Joint STARS Joint Program Office (JPO) is a joint Army/Air Force program office to manage the full scale development of Joint STARS. A component of the JPO operates from Fort Monmouth, NJ.

6. (U) WORK PERFORMED BY: The Joint STARS program is managed by a Joint Program Office, ESD/JS, at Hanscom AFB MA. The prime contractor for Joint STARS is Grumman Aerospace Corp, Bethpage, NY through its new operating division, Grumman Melbourne Systems Division, Melbourne FL. Major subcontractors are Norden Systems, Norwalk CT, Boeing Military Airplane Co, Wichita KS and Control Data Corp, Minneapolis MN. MITRE Corp, Bedford MA, assists the Joint Program Office in overall concept studies, test planning and evaluation of demonstrated results, preparation of technical specifications, and technical analyses. The Joint STARS GSM is being developed by Motorola Corp, Tempe AZ.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 64770F, Joint STARS

A. Project Description: There is no other system planned to provide real time wide-area surveillance of the battlefield, closed loop target detection and tracking and real-time attack targeting against first and second echelon armor. Joint STARS will be the only DOD system able to provide the "electronic high ground" to the Corps and Division commanders. Joint STARS provides a 2-5 day advance look at enemy second echelon force build-ups, force movements, and the enemy's scheme of maneuver on the battlefield. This early information on the enemy's battle plan will allow the Corps commander to react, even before the enemy battle plan is executed, with maneuver and economy of force to engage the enemy at a time and place of the Corps commander's own choosing. Additionally, Joint STARS closed-loop moving targeting detection, tracking, and targeting permit the direction of direct attack aircraft, artillery, and standoff missiles

against ground targets in real time, compared with current interdiction missions which are performed on a preplanned basis. The Joint STARS will be the only DOD system able to target attack aircraft or standoff missiles against moving ground targets in near real time. This project provides full scale development of the Joint STARS, an Army/Air Force program for an airborne radar and engagement system to detect and track enemy ground movers, and direct accurate attacks against these targets using conventional weapons. The multi-function Joint STARS performs wide area battlefield surveillance, attack planning, attack control, and post attack assessment functions. The system includes multi-mode radar, communications, and operations and control subsystems, all installed in an E-8A (formerly called C-18) aircraft, which is a militarized Boeing 707. The radar uses a large, electronically agile antenna to rapidly scan the areas of interest to the combat commander, using the Moving Target Indicator mode. The radar can also time share a Fixed Target Indicating mode using synthetic aperture radar technology, and can provide real-time target location updates to tactical aircraft. The radar is modular, and is constrained in weight and volume to insure that it is adaptable to both the E-8A and to follow-on aircraft. The operations and control subsystem includes the displays, computers, and weapon controllers/analysts used to exploit the wealth of radar data. The communications capabilities include various voice radios as well as data links which will transmit Joint STARS surveillance data omnidirectionally to combat commanders without delay. The E-8A will carry a self-defense suite to increase survivability in high threat environments. The self-contained E-8A concept, with radar and operations/control capabilities in one aircraft, is particularly well suited to rapid deployment contingency operations. Potential target engagement capabilities of the Joint STARS system, based on technology demonstrated by the PAVE MOVER radar of the Assault Breaker technology demonstrations, include cue vectoring of low altitude aircraft and targeting of standoff air-to-surface and surface-to-surface missiles.

The PAVE MOVER demonstration program technology has been incorporated into the Joint STARS system design. PAVE MOVER technology proved capable of detecting and tracking slow moving ground vehicles to ranges of and within abeam the aircraft. PAVE MOVER also demonstrated a small area fixed target image mode with a resolution for the detection and location of stopped vehicles. To provide a high probability of target destruction, the PAVE MOVER Engagement System used its narrow beam radar to send accurate guidance commands to both standoff missiles and attacking aircraft. Total system strike accuracy using the PAVE MOVER relative guidance was designed for Circular Error Probable (CEP) at PAVE MOVER provided accurate guidance for surface-to-surface missiles carrying anti-armor sub-munitions. Missiles were directed within a dispensing area above a moving armored column at a range of , PAVE MOVER also cue-vectored an F-4 tactical aircraft on low altitude bombing runs against moving armor, with a CEP of

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: The proven PAVE MOVER technology was matured in the first full year of full scale development. Significant risk reduction/development efforts were accomplished to include fabrication of radar antenna elements and subarrays, high power transmitter brassboard tests, and signal processor chip design, fabrication

and test. The government conducted system design review, hardware preliminary design review (PDR) and began software preliminary design review. Contractors purchased off-the-shelf components and the government began purchase of government furnished equipment. Studies of integrated logistics support, joint training, basing concepts, and total systems effectiveness continued. Subsystem build-up began and brassboard subsystem development continued. Militarization of two Boeing 707 aircraft began.

(2) (U) FY 1987 Program: The airborne segment consisting of the E-8A, radar, operations and control, and communications subsystems will complete system critical design review. Militarization of the RDT&E E-8A aircraft will be completed. Brassboard hardware elements will complete development, test and laboratory integration. The components of the operations and control subsystem will be tested and integrated. Components of the communications subsystem will be integrated into the test aircraft. Roof top tests of the first radar will begin. Software coding will begin. Logistics repair analysis will continue and analysis of support equipment and pre-operational spares will begin. Ground terminals of the surveillance and control data link will be integrated into the Ground Station Module (GSM), which is being developed by Motorola under a separate Army contract. Planning for European Field Test Demonstration will begin. The Operational Utility Evaluation (OUE) computer simulations and analysis to support the Milestone IIB will be completed. OUE emphasis will be on system survivability, battlefield management, situation development and targeting. The Milestone IIB force structure and product improvement review will be completed. The full scale development of the Joint STARS GSM) will continue.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Radar, operations and control console and communications subsystems hardware fabrication and integration will be completed. Contractor engineering flight testing will begin. Software integration testing and qualification will continue. Ground beacon test articles will be delivered. System logistics development and support will continue with emphasis on peculiar support equipment development, maintenance planning, provisioning, pre-operational logistics support and technical manual development activities. Ground testing and TEMPEST testing will be completed. Detailed test planning for the Field Test Demonstration (FTD) in Europe will continue. The E-8A self defense suite effort to integrate and field appropriate off-the-shelf radar warning receiver and other counter-measures equipment will begin. Army Ground Station Module (GSM) hardware will be delivered for integration testing with the E-8A. Production planning will continue. Beddown planning will continue. Necessary construction planning will continue to support the FY 1992 Limited Operational Capability. The request for this program is based on a class II cost estimate. An initial Category II (mature) Independent Cost Analysis (ICA) was performed prior to the Joint STARS DSARC IIA in 1985. The full scale development fixed price contract was negotiated and awarded in September 1985.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Contractor system level testing will be completed. Incremental software audit/qualification reviews will be completed. System level performance will be verified. The government test team will be fully manned and trained for the develop and operational testing and evaluation. Peculiar Support Equipment, technical manuals and pre-operational spares will be delivered to the test program. Reliability improvement efforts will continue as high failure rate piece parts are identified and modifications

made to increase system effectiveness. Beddown plans will be finalized and the military construction design process will begin. The E-8A self defense suite integration will continue. Detailed planning for testing and the deployment for the Field Test Demonstration (FTD) will continue. The Army will conduct an in-process review production decision for the GSM. Final Configuration Audits and Physical Configuration Audits begin.

(5) (U) Program to Completion: The combined government Development Test and Evaluation (DT&E)/Initial Operational Test and Evaluation (IOT&E) will be completed. The Joint STARS program, including the European FTD, will complete initial full scale development in FY 1990. Additional research and development efforts for enhanced capabilities will continue after the inital program is completed. A production program request for proposal will be released and the response will be evaluated by the government. An independent cost analysis for the production program will be performed. A low rate rate initial production decision to meet a Limited Operational Capability (LOC) during FY 1992 will be conducted in FY 1990. Development and Initial Operational Test and Evaluation and Production Readiness Reviews will be completed in FY 1990. The Operational Utility Evaluation field tests and command post exercises, to examine in detail the utility of the system, will be completed prior to the Milestone III full production decision. Production of the 10 E-8A aircraft will be completed.

C. (U) Major Milestones:

		Milestones		Dates
(1)	(U)	Release of Modified Full Scale Development Request for Proposals		September 1984
(2)	(U)	Contract Award for Full Scale Development		September 1985
(3)	(U)	Preliminary Design Review, Hardware	*(March 1986)	May 1986
(4)	(U)	Preliminary Design Review, Software	*(September 1986)	February 1987
(5)	(U)	Critical Design Review, Hardware	*(January 1987)	March 1987
(6)	(U)	Critical Design Review, Software	*(April 1987)	August 1987
(7)	(U)	Combined Govt Development/Initial Opnl Test & Eval Begins	*(December 1988)	November 1989
(8)	(U)	European Field Test Demonstration Begins		October 1989
(9)	(U)	Full Production Decision		October 1990
(10)	(U)	Limited Operational Capability (LOC)	*(N/A)	FY 1992

* Date presented in FY 1987 Descriptive Summary.

(U) Explanation of Milestone Changes

(3) (U) System hardware PDR delayed by subcontractor PDR schedules
(4) (U) System software PDR delayed due to slow contractor manning build-up and redefinition of software development planning. Four phase software PDR began on schedule in September 1986 and will conclude in February 1987. The overall program is not impacted, although subsequent software milestones are affected.

(5) (U) The Hardware CDR delay results from the previous delays from the scheduled Hardware PDR.
(6) (U) The Software CDR delay results from the previous delays from the scheduled Software PDR.
(7) (U) The FY 87 Descriptive Summary schedule date of December 1988 reflected the beginning of contractor DT&E. The revised milestone reflects the beginning of government DT&E.
(10) (U) Limited operational capability defined and added to milestone schedule.

9. (U) COOPERATIVE AGREEMENTS: The Air Force has initiated a Joint STARS NATO Cooperative R&D program (PE 63790F, Project 3639) in FY 1987. This project funds promising development and study efforts in a cooperative R&D program to strengthen ties between the US and our Allies, avoid wasteful duplication of effort among the NATO Allies and enhance NATO Rationalization, Standardization and Interoperability. This program exploits the Joint STARS system architecture of partitionable subsystems which are suited to confederated development. This initiative tailors cooperative development to system upgrades which suit the needs and interests of the participating countries. In addition, the Airborne Radar Demonstrator System (ARDS) is a cooperative agreement for demonstrating a combined ground and airborne radar for wide-area surveillance. The agreement to conduct the demonstration has been signed by the United States, France and the United Kingdom. The Federal Republic of Germany is expected to participate as an observer in the future. The US Army is the executive agent for the ARDS. Details of this project are provided in the Army documentation for PE 64770A.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64779F   Title: Joint Interoperability of Tactical Command and Control Systems (JINTACCS)
DOD Mission Area: 344 - Tactical Command and Control   Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		8,303	9,382	6,040	6,085	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: JINTACCS is a joint interoperability program to improve the operational effectiveness of service (Navy, Army, Air Force, and Marine Corps) Tactical Command & Control Systems used in support of joint operations. The program element supports Air Force participation in the JINTACCS Program with the Marine Corps, Navy, Army, and the Joint Tactical C^3 Agency which acts as the Executive Agent. Service and agency activities are governed by jointly agreed upon and Joint Chiefs of Staff approved documentation including Technical Interface Concepts and Technical Interface Design Plans. Close liaison across each of the JINTACCS programs precludes duplication of efforts. Elements of the Tactical Air Intelligence System, E-3, and Joint Tactical Information Distribution System (JTIDS) participate in this program. The JINTACCS program (formerly GAMO) is directed by Joint Chiefs of Staff Memorandum (SM) 205-71 dated 1 April 1971, as modified by a Secretary of Defense memorandum, "Reorganization of the DOD Program to Achieve Interoperability of Tactical Command and Control Systems for Ground and Amphibious Military Operation (GAMO)," dated 2 Aug 1977. The program complies with requirements of Department of Defense Directive 4630.5, "Compatibility and Interoperability of Tactical Command, Control, Communications and Intelligence Systems." The structure of the program is established by the JINTACCS Program Summary which is reviewed and approved annually by the Assistant Secretary of Defense for Command, Control, Communications and Intelligence. Tactical Air Forces Required Operational Capability 306-74 (validated 4 Oct 74) is the requirement supporting JTIDS.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	8,908	9,866	6,218	N/A	Continuing	N/A

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: The Service and Agency related JINTACCS program elements/projects are: PE 64780M, Joint Interoperability for Tactical Command Control Systems; PE 64779N, JINTACCS Program; PE 64779A, JINTACCS; PE 28045D, C^3 Interoperability (Joint Tactical C^3 Agency); and PE 28298D, Management Headquarters.

6. (U) WORK PERFORMED BY: The Tactical Air Force Interoperability Group (TAFIG), Langley AFB, VA, is coordinating and implementing authority for Air Force participation in the Joint Chiefs of Staff JINTACCS Program. Management responsibility for R&D funding is assigned to the Air Force Systems Command, Electronic Systems Division, Hanscom AFB, MA. The Tactical Air Command provides operational support, including a Participating Test Unit at the Air Force Tactical Systems Interoperability Support Center at Langley AFB, VA, to support compatibility and interoperability testing and operation effectiveness demonstrations. The JINTACCS contractors are Systems Development Corporation, McLean, VA; Martin Marietta, Denver, CO; and the MITRE Corporation, a Federal Contract Research Center, located at Bedford, MA.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 64779F, Joint Interoperability of Tactical Command and Control Systems:

A. (U) Project Description: Joint Interoperability of Tactical Command and Control Systems was started in August 1977 as the successor to the Ground and Amphibious Military Operation Program. Its purpose is to improve the operational effectiveness of the Services (Army, Navy, Air Force and Marine Corps) command and control systems used in support of joint operations through the 1980s. Also incorporated are the intelligence facilities of the National Security Agency and the Defense Intelligence Agency. NATO interoperability considerations were added in 1978. The Services and Agencies use the program to develop common interface standards and to modify their command and control equipment and procedures as necessary to insure systems interoperability, compatibility and operational effectiveness. To facilitate management, the program is divided into the following functional segments: intelligence, air operations, maritime operations, fire support, operations control, and Tactical Digital Information Link "J" (TADIL J). Within the Air Force, the primary command and control facility interfaces to be analyzed and defined exist within the Tactical Air Control Center (TACC), Control and Reporting Center/Post, Air Support Operations Center, Airborne Warning and Control System, Airborne Battlefield Command and Control Center, and the intelligence element supporting the TACC. An Air Force test facility known as the Participating Test Unit has been established to evaluate Air Force modified command, control and communications elements, to support testing and demonstrations, and to provide ongoing configuration control. The JINTACCS program follows a procedure where Technical Interface Concepts are defined and the initial Technical Interface Design Plans - Test Editions (TIDP-TE) are completed. Following modification of the test systems, Developmental Certification Testing is performed, the TIDP-TE modified, Operational Effectiveness Demonstration conducted, and a final TIDP published for incorporation into JCS publications. The overall goal is to achieve joint compatibility and interoperability among tactical command and control systems from each service.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Conducted interface planning, analysis and design efforts as well as modification of test-only hardware and software. The development of the Simulation, Monitoring, Analysis, Reduction, Test System (SMARTS) for the Participating Test Unit (PTU) at Langley AFB, VA, was completed, and development of the SMARTS capability for the 552nd Airborne Warning and Control (AWAC) Wing at Tinker AFB, OK, continued. Development of the combat service functional segment began.

(2) (U) FY 1987 Program: Continues interface planning, analysis and design efforts, the development of the Simulation, Monitoring, Analysis, Reduction, Test System (SMARTS) capability for the 552 AWAC Wing, and the development and testing of the combat service support functional segment. Also, development of the Tactical Digital Information Link "J" (TADIL-J) test capability for the Air Force Participating Test Unit (PTU) will begin.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Interface planning, analysis and design efforts will continue. The SMARTS for the 552nd AWAC Wing will be completed. Development and testing for the combat service support functional segment will continue as well as development of the Joint Tactical Information Distribution System (JTIDS) test capability for the Air Force PTU. Estimates for the FY 1988 effort are based on negotiated contract (cost estimating category I) or on engineering planning estimates (cost category III).

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Funds are provided to continue the development of the JTIDS test capability, integrate TADIL-J equipment, and begin simulation testing of the TADIL-J message standard. Estimates for the FY 1989 effort are based on negotiated contracts (cost estimating category I) or on engineering planning estimates (cost category III).

(5) (U) Program to Completion: The continuing program will support functional segment testing for compatibility and interoperability and operational effectiveness demonstrations. The TADIL-J test capability for the PTU will be completed. Technical interface design plans will be updated and subsequently incorporated as standards into Joint Chiefs of Staff Publication 2.

C. (U) Major Milestones:

		Milestones	Dates
(1)	(U)	Intelligence Operational Effectiveness Demonstration	May 1981
(2)	(U)	Air Operations/Intelligence Operational Effectiveness Demonstration	May 1983
(3)	(U)	Operations Control, Fire Support, Maritime, Air Operations and Intelligence Combined Functional Segment - Operational Effectiveness Demonstration	May 1985
(4)	(U)	JINTACCS Message Text Formats Joint Service Implementation	September 1986
(5)	(U)	Tactical Digital Information Link "J" (TADIL-J) Development Certification Testing (DCT) start	July 1990
(6)	(U)	TADIL-J DCT complete	July 1992

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

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FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 27129F
DOD Mission Area: 223 - Close Air Support and Interdiction

Title: F-111 Squadrons
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	36,042	16,991	25,656	20,136	TBD	TBD
2056	PAVE TACK	365	0	0	0	0	15,530
2952	F-111 Avionics Intermediate Shop (AIS)	20,302	1,641	0	0	0	93,750
2962	F-111 Avionics Modernization Program (AMP)	9,900	750	2,000	480	0	113,952
3079	F-111 Digital Flight Control System (DFCS)	5,475	14,600	23,656	19,656	TBD	TBD

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides funds for development activities associated with the F-111 aircraft. Project 2952 is an engineering effort to replace the existing F-111 AIS Automatic Test Stations which have become technologically obsolete, unreliable, and logistically unsupportable. The F/FB-111 AMP (Project 2962) is a reliability/maintainability improvement to the bomb/navigation system required to reduce maintenance and support costs associated with high failure, high cost, and technologically outdated components. Project 3079, the DFCS is a development effort to replace the analog flight control system with a digital system to eliminate safety deficiencies (uncommanded flight maneuvers) and improve reliability and maintainability.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	47,253	35,236	27,842	N/A	21,920	317,932
Aircraft Procurement*	230,500	219,400	197,500	N/A	207,600	1,056,400

EXPLANATION: (U) FY 1986 and 1987 RDT&E decreases are the result of Congressional actions and general Air Force budget reductions. FY 1988 RDT&E decrease ($2.2 million) was required for higher priority programs. Procurement cost differences (FY 1986 and out) reflect rescheduling of F-111 AMP kit buys. F-111 DFCS RDT&E funding may require adjustment after source selection in early 1987.

* Includes F-111 Avionics Modernization Program (AMP) kit costs only

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
F-111 Avionics Modernization Program (AMP)						
Aircraft Procurement:						
Funds	235,500	211,000	195,100	99,400	95,000	1,039,800
Quantities (Kits)	(90)	(120)	(60)	(35)	(27)	(388)
F-111 Digital Flight Control System (DFCS)						
Aircraft Procurement:						
Funds	0	0	0	0	108,700	108,700
Quantities (Kits)	(0)	(0)	(0)	(0)	(400)	(400)

5. (U) RELATED ACTIVITIES: Not Applicable

6. (U) WORK PERFORMED BY: The F-111 Avionics Intermediate Shop (AIS) contractors are Westinghouse, Baltimore, MD, and Bendix, Tatarboro, NJ. The F-111 AMP contractors are General Dynamics Corporation, Ft. Worth, TX for the FB-111 aircraft; and Grumman Aerospace Corporation, Bethpage, NY for the F-111A/E and EF-111 aircraft. The DFCS contract award will be made during the second quarter of FY 1987. The F-111 System Manager is located at Sacramento Air Logistics Center, McClellan AFB, CA. The DFCS development effort is managed at Aeronautical Systems Division, Wright-Patterson AFB, OH. The F-111 AIS development effort is managed at San Antonio Air Logistics Center, Kelly AFB, TX.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2962, F-111 Avionics Modernization Program (AMP). The F/FB-111 AMP is a low risk reliability/maintainability upgrade to the bomb navigation system of the FB-111, F-111 A/E/D/F, and EF-111. This modification involves the substitution, modification, and repackaging of 16 Line Replaceable Units in the following subsystems: Inertial Navigation System, Terrain Following Radar, Attack Radar, Doppler Radar, Controls and Displays, and Data Transfer Unit. This modification is expected to raise the mean time between failure of the overall system from the current 5 hours to approximately 20 hours and will ensure system supportability into the 1990s. During FY 1986 completion of all AMP aircraft design activities and final software program refinement was accomplished. Integrated

flight tests were performed and all design/deficiency changes completed. Test Analyze And Fix and Combined Environmental/Reliability Test (CERT) requirements were also accomplished. At the close of FY 1986, all design reviews were completed and preproduction hardware was under test. In FY 1987 this project will provide for the production incorporation and retrofit of the changes resulting from the CERT and any residual tasks remaining following the program management responsibility transfer of the radars. In addition, integrated flight tests will be completed. The first modified FB-111 was delivered in December 1986. During FY 1988 an effort will be initiated to develop Test Program Sets required to support Avionics Modernization Program (AMP) terrain following and attack radar line replaceable units at the intermediate maintenance level. All TPS and F-111 AMP engineering development efforts will be completed in FY 1989.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3079, F-111 Digital Flight Control System (DFCS)

A. (U) Project Description: The DFCS is a Class IVA safety modification that replaces the electronic portion of the F/FB/EF-111 flight control system with a modern state-of-the-art digital computer and sensors. This project will also improve the critical interfaces of the flight control system by incorporating the on-board autopilot and low altitude monitor, and monitoring the terrain following radar systems. As a by-product of this safety modification, the system reliability of the flight control system will be improved.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Developed, reviewed, and released the Request for Proposal for the full scale development (FSD) and production options for the Digital Flight Control System (DFCS). In addition, an acquisition plan, source selection plan, and contract strategy plan were written and approved. Finally, proposals were received from prospective contractors and source selection initiated.

(2) (U) FY 1987 Program: Source selection will be completed and a contract awarded to one prime contractor in 2Q FY 1987 for FSD. Initial design will begin, contractor manpower will be increased and Preliminary Design Review will be conducted.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Design and system engineering development activities will peak during the first full year of DFCS FSD. Engineering development models will be constructed and the Critical Design Review will be conducted to finalize functional design parameters. Testing of hardware prototypes and software simulation activities will begin.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Prototypes for Safety of Flight testing, qualification testing, and test aircraft installation will be delivered. The first F-111 test aircraft will be modified and undergo functional flight test. Development, Test, and Evaluation (DT&E) will begin for the F-111F or FB-111A aircraft.

(5) (U) Program to Completion: Development Test and Evaluation of the first modified F-111 aircraft will be completed and Initial Operational Test and Evaluation will be conducted. An EF-111A aircraft will undergo flight testing. Low rate initial production will provide initial kitproof production kits in FY 1991. Full rate production and modification of all F-111 models will complete in FY 1994.

C. (U) Major Milestones:

Milestones	Dates
(1) (U) Contract Award	1st Quarter FY 1987
(2) (U) Critical Design Review	2nd Quarter FY 1988
(3) (U) Flight Test	3rd Quarter FY 1989 - 2nd Quarter FY 1991
(4) (U) Start Kit Deliveries	2nd Quarter FY 1991

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

ogram Element: 27130F
DOD Mission Area: 221 - Counter Air

Title: F-15-Squadrons
Budget Activity: 4 - Tactical Programs

(U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

oject mber	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TAL FOR PROGRAM ELEMENT		217,668	156,069	118,564	69,340	180,363	3,315,636
31	F-15 Squadrons	144,553	77,369	76,164	63,940	180,363	3,021,757
32	F-15E Unique Cap.	73,115	78,700	42,400	5,400	0	293,879

(U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The F-15 is a high performance, highly maneuverable fighter uipped with long-range look-down radar and a balanced mix of air-to-air weapons to provide medium range, all weather d close-in kill capability. Designed specifically to gain and maintain air superiority, the F-15 has significantly graded USAF capability in the counter-air and air defense missions. The F-15E retains the basic air-to-air capability d adds systems necessary to meet the requirement for all weather, deep penetration and night/under-the-weather r-to-surface attack. Continued production of the F-15E satisfies force structure requirements for deep interdiction.

(U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	229,993	208,988	106,473	N/A	171,000	3,288,864
Aircraft Procurement	1,962,300	2,027,300	2,131,300	N/A	12,238,300	35,181,400

Explanation: (U) The RDT&E and procurement requirements are based on a grassroots estimate completed in October 86 and reflect a restructured program as a result of Congressional reductions in FY 1986 & 1987. RDT&E changes were iven by the required rephasing of funding requirements to later years and revised estimates for flight test quirements and ECCM development efforts. In addition, FY 1988 changes are primarily due to adding Global Positioning stem (GPS) integration and Multi-Source Integration to the program. Production decreases are attributable primarily reductions in the airframe estimate resulting from a "Should Cost" study performed in mid-1986 and additional ductions to the propulsion line due to the benefits of competition.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Aircraft Procurement:						
Funds	1,773,652	1,760,165	1,654,900	1,734,000	10,098,300	33,754,628
Quantities	48	42	42	42	258	1266

5. (U) RELATED ACTIVITIES: The Tactical Electronic Warfare System for F-15 application is being developed in PE 64739F, Tactical Protective Systems. AIM-9M and AIM-7M (Advanced Monopulse Seeker) air-to-air missiles are being procured for use on the F-15 and other aircraft under PE 27161F, Tactical Air Intercept Missiles. The Joint Tactical Information Distribution Systems (JTIDS) is being developed for use on multiple aircraft including the F-15 under PE 64754F, JTIDS. The Advanced Medium Range Air-to-Air Missile (AMRAAM) is being developed under PE 64314F, AMRAAM. The F-15 Ring Laser Gyro inertial navigation unit is being developed for F-15E production and subsequent F-15A-D retrofit under PE 64201F, Aircraft Avionics Equipment Development. Capability is being developed under PE 64406F, Space Defense Systems, for designated air defense F-15s to support the air launched anti-satellite (ASAT) mission. The Low Altitude Navigation and Targeting Infrared System for Night (LANTIRN) is being developed for the F-15E under PE 64249F, Night/Precision Attack. The Improved Performance Engine is being developed under PE 64223F, Alternate Fighter Engine.

6. (U) WORK PERFORMED BY: The F-15 development program is being managed by the F-15 Program Office, Aeronautical Systems Division, Wright-Patterson Air Force Base, OH. McDonnell-Douglas Corporation, St. Louis, MO, is the prime contractor for development and production of the F-15 aircraft. Pratt & Whitney division of the United Technology Corporation, West Palm Beach, FL, is the engine contractor. Hughes Aircraft Company, Culver City, CA, is the radar subcontractor to McDonnell-Douglas Corporation.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 0131, F-15 Squadrons

A. (U) Project Description: The F-15 is the most capable air superiority fighter in the world today. As such, it is the cornerstone to the accomplishment of all other tactical missions. With conformal fuel tanks, the F-15 can deploy worldwide with minimal tanker support and arrive in a combat ready configuration. However, the Soviet/Warsaw Pact threat continues to grow quantitatively and qualitatively with their new generation of aircraft possessing all-weather detection and kill capabilities. To maintain the F-15's superiority against the threat in the mid-1980s and through the 1990s, avionics, armament, airframe, and engine improvements are required. Avionics changes which exploit proven

technological advances are being incorporated into the F-15 to provide expanded air combat identification (ID) capability, updated electronic warfare suite, and incorporation of improved communication/identification equipment. In addition, this project develops enhanced capability for the secondary air-to-ground role. Improvements include a higher maximum takeoff weight, air-to-ground modes for the radar, an improved inertial navigation system, and increased capacity generators. These improvements are grouped into a comprehensive, cost effective Multi-Staged Improvement Program (MSIP). In addition, overall combat capability will be increased by integration of an Increased Performance Engine (IPE).

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: FY 1986 RDT&E funds were used for the continuation of development and testing of the MSIP simulator, MSIP hardware and software, electronic counter-countermeasures, enhanced tactical electronic warfare system, and weapons certification for new weapons. Full scale development began for support equipment for the Tactical Electronic Warfare System (TEWS).

(2) (U) FY 1987 Program: FY 1987 RDT&E planned efforts include continued development and testing of integrated MSIP systems and MSIP radar ECCM updates, development of TEWS support equipment, and start of integration of the IPE.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: FY 1988 RDT&E program continues development and testing of the improvements initiated in FY 1987 and prior. These improvements are required to meet the evolving air-to-air threat and enhance the inherent air-to-ground capability of the aircraft. The upgraded systems also serve as a baseline from which to add the unique systems necessary for the F-15E mission. Planned efforts include final design, test and checkout of all Multi-Staged Improvement Program (MSIP) changes and peculiar support equipment to ensure system compatibility, continued Improved Performance Engine (IPE) integration, and continued Electronic Counter-counter Measure (ECCM) enhancement. The FY 1988 RDT&E request is based on in-depth grassroots estimates (category I—comprehensive) completed in October 1986.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The FY 1989 RDT&E program will continue flight test and RDT&E tasks associated with Seek Eagle, Phase IV Tactical Electronic Warfare System (TEWS) system integration, ALQ-135 Band 1.5/3 jammer integration, TEWS Intermediate Support System (TISS) development, Increased Performance Engine integration, advanced algorithm dual mode recognizer (DMR), Memory module test system and radar module test station. The FY 1989 RDT&E request is based on in-depth grassroots estimates (category I—comprehensive) completed in October 1986.

(5) (U) Program to Completion: Program funding will enable completion of tasks underway including radar improvements, ECCM improvements, added capability for electronic warfare test equipment, and additional flight testing for safety and operational deficiencies.

C. (U) F-15A-D Major Milestones:

	Milestones	Date
(1) (U)	Advanced Development Initiated	January 1970
(2) (U)	Initial Contract	January 1970
(3) (U)	Critical Design Review	April 1971
(4) (U)	Delivery & 1st Flight, 1st Aircraft	July 1972
(5) (U)	Long Lead Production Decision	October 1972
(6) (U)	Full Production Decision	February 1973
(7) (U)	Initial Operational Capability	July 1975
(8) (U)	Multi-Staged Improvement Program (MSIP) Initiated	June 1982
(9) (U)	Delivery, 1st F-15C/D MSIP Aircraft	June 1985
(10) (U)	Planned Delivery, last F-15C/D MSIP aircraft	May 1988

9. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 0132, F-15E Unique Capability

A. (U) Project Description: The F-15E will be a high performance, highly maneuverable fighter equipped with a mix of air-to-air and air-to-surface weapons. The F-15E configuration will include missionized cockpits, Low Altitude Navigation, Targeting, and Infrared for Night (LANTIRN) capability, automatic terrain following, and other improvements. These improvements are necessary to fulfill an urgent need for an aircraft which retains basic air superiority capability, but can provide all weather navigation, deep penetration, and night/under-the-weather attack with large air-to-surface weapons payloads. This project develops and tests the changes required by the F-15E unique mission.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: The FY 1986 RDT&E program continued full scale development and testing of the F-15E systems and support equipment initiated in FY 1985 and prior. F-15E hardware/software development continued with increased emphasis on systems integration. Contractor and government efforts shifted from component testing to subsystem/system integration efforts paralleling hardware/software development. Funding for instrumentation of tests assets was included.

(2) (U) FY 1987 Program: The FY 1987 RDT&E program continues F-15E hardware/software development effort with emphasis on design support to incorporate changes developed in FY 1986 testing. Funding will provide for initial flight testing and in-depth ground testing. The first flight of the F-15E was successfully accomplished on 11 December 1986.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The FY 1988 RDT&E program will include final development, integration ground and flight testing associated with F-15E subsystems and weapons integration discussed above. Problems and proposed resolutions will be identified. The FY 1988 RDT&E request is based on in-depth grassroots estimates (Category I-comprehensive) completed in October 1986.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The RDT&E program for FY 1989 will complete this project. Planned efforts include resolution of issues identified during the FY 1988 RDT&E program, incorporation of any necessary software changes, and documentation of RDT&E results. The FY 1989 RDT&E request is based on in-depth grassroots estimates (Category I-comprehensive) completed in October 1986.

(5) (U) Program to Completion: Program funding completed in FY 1989.

C. (U) F-15E Major Milestones:

Milestones	Date
(1) (U) F-15/F-16 Flight Evaluation Complete	June 1983
(2) (U) Statement of Need Validated	January 1984
(3) (U) F-15E Development Decision	February 1984
(4) (U) Award Development Contract	April 1984
(5) (U) Delivery & First Flight, F-15E #1	December 1986
(6) (U) F-15E Initial Operational Capability (IOC)	FY 1989

10. (U) COOPERATIVE AGREEMENTS: Not Applicable.

Budget Activity: 4, Tactical Programs
Program Element: 27130F, F-15 Squadrons

Test and Evaluation Data

(U) The F-15 test program encompasses Contractor Development Test and Evaluation (CDT&E), Air Force Development Test and Evaluation (AFDT&E), Air Force Initial Operational Test and Evaluation (IOT&E) and Follow-on Operational Test and Evaluation (FOT&E). The purpose of CDT&E and AFDT&E was to provide necessary test and analysis data to assure that an operational air superiority weapon system would be available at the earliest practical time. Test objectives addressed compliance with specifications, established performance capabilities, evaluated handling quantities, etc. IOT&E was conducted throughout Development Test and Evaluation (DT&E) to evaluate the operational capability and suitability of the F-15 weapon system. A portion of Tactical Air Command's (TAC) IOT&E involved their participation in eleven F-15 Air Force Preliminary Evaluations (AFPE). Additionally, seven Initial AFDT&Es were conducted during DT&E to permit Air Force Flight Test Center and TAC pilots to evaluate contractor fixes of mandatory correction items discovered during AFPEs and to accomplish early Air Force developmental and operational test objectives. Eighteen F-15As and two F-15Bs (two-seat version) were dedicated to the DT&E/IOT&E tests.

1. (U) Development Test and Evaluation (DT&E): As of 30 September 1986, the USAF and McDonnell Douglas DT&E test teams had accumulated 11988 test flights and 15351 flight hours on F-15 test aircraft during 169 months of F-15 DT&E. This paragraph summarizes the significant DT&E accomplishments in the F-15 program from the beginning of full scale development in January 1970 through October 1986. The air vehicle critical design review and the avionics equipment development review were completed in April and June 1971, respectively. From July 1971, efforts were directed to fabrication of components and flight test airplanes and extensive ground testing of subsystems. Three demonstration milestones were completed in February 1972, including the Engine/Inlet Compatibility Test, the Structural Test of Major Subassemblies, and the Engine Preliminary Flight Rating Test (PFRT) Milestones. To obtain increased engine efficiencies over the PFRT engine (Series I configuration) the Air Force decided, in March 1972, to use the alternate design being carried as a parallel effort. This engine became Series II, the configuration planned for Military Qualification Tests and for subsequent production. F-15 first flight occurred on 27 July 1972 beginning a highly successful flight test program. The flying qualities Air Force Preliminary Evaluation (AFPE) was completed in September, 1972, with favorable results. The initial Airborne Avionics Performance Milestone was completed on 2 December 1972. Two structure demonstration milestones were completed in January 1973, including the Fatigue Test to One Lifetime and Static Test to Critical Conditions. The F100 engine endurance qualification test, delayed beyond planned completion date of February 1973 by technical problems, was successfully completed on 12 October 1973.

(U) All major structural testing milestones were met when the fatigue tests to three and four lifetimes were completed in March 1974. The AFDT&E began at Edwards AFB in February 1974. The external Stores Flutter Release Milestone was completed in August 1974. With the exception of a single aircraft conducting limited armament follow-on testing, all CDT&E was completed in November 1974. All high angle-of-attack and spin testing was completed in August 1975. The Equipment Qualified Milestone was completed in March 1977, and the Aerospace Ground Equipment In-Place

Budget Activity: 4, Tactical Programs
Program Element: 27130F, F-15 Squadrons

Milestone was completed in May 1977. Flight evaluation of the Air Intercept Missile Evaluation/Air Combat Evaluation changes to the computer software, F-15/F-16 radar mutual interference tests, and the AIM-9L integration effort were completed in 1978.

AFDT&E of the AN/ALR-56 Radar Warning Receiver (RWR) "New Threat" program was completed and an interim flight test report published in 1978. The New Threats consisted of three major improvements. One feature allows the ALR-56 to sort out and analyze capability. A second modification gives increased capability to detect threats that are The final change, termed Successful operation of the was demonstrated. However, the software tape still had New Threat related problems as well as some carry-over deficiencies from the current Operational Flight Program. Further development and testing was required before release. The AN/ALR-56A version B is fielded.

(U) The AN/ALR-56C Radar Warning Receiver update is a normal development program with Quick Reaction Capability (QRC) production acceleration. The update provides an expanded reception envelope to cover current threats and a fast timing receiver to detect new agile airborne interceptor (AI) threats. DT&E/IOT&E flight testing is scheduled through June 1987. Initial fielding of the system is expected late fall 1986 at the 33rd Tactical Fighter Wing, Eglin AFB, FL.

The AN/ALQ-135 Internal Countermeasures Set (ICS) update program is a QRC program to add a Band 3 jammer for Electronic Countermeasures against Compass Glory threats. This program replaces one of the existing Band 2 systems with a Band 3, thereby increasing frequency coverage of the ICS from the current system Upper hemispheric coverage and sophisticated jamming techniques are also included. Feasibility demonstration testing with a modified AN/ALR-56A RWR was completed in January 1984. Combined DT&E/IOT&E of the system began in June 1986. This testing will initially be "stand alone" ICS testing and will evolve to an integrated test involving the AN/ALR-56C and AN/ALE-45 Countermeasures Dispenser. Target date for completion of the fully integrated Tactical Electronic Warfare System testing is the 4th Qtr FY 1987.

(U) In 1978, CDT&E and AFDT&E of the Jet Fuel Starter air start capability were completed. Testing under the F100 Engine Component Improvement Program, including solutions to the F100 stall/stagnation problem, continued throughout 1979 and 1980. The susceptibility of the F100 engine to compressor stalls followed by stagnations and the resultant durability problems have been areas of major concern. With incorporation of fixes, the F-15 stall/stagnation rate of 1.0 incident per 1000 engine flight hours was reduced to .5 incident per 1000 engine flight hours. Development and test of the F-15 C/D model, Production Eagle Package 2000 improvement (2,000 lbs additional internal fuel, provisions for conformal fuel tanks and capability for higher takeoff gross weight), which was initiated in mid-1976, was completed in late 1980. CDT&E and AFDT&E of the C/D model, which began in February and May 1979, respectively, were completed in 1980.

Budget Activity: <u>4, Tactical Programs</u>
Program Element: <u>27130F, F-15 Squadrons</u>

(U) Finally, development and test of the programmable signal processor (PSP) for the F-15 radar, which began in 1978, continued through 1980. While containing some minor discrepancies, the first PSP operational flight program delivered in May 1980 was as good or better than current aircraft radar capabilities. The discrepancies were corrected with a tape revision in October 1980. The development of the Raid Assessment Mode (RAM) took longer than originally expected and was not incorporated until May 1981.

(U) The F-15 Programmable Signal Processor (PSP) Radar Improvement Program (PRIP) which began in June 1981 has been completed. The Engineering Change Proposal (ECP) 1518, Phase I DT&E at Edwards was initially completed 1 August 1983. This tape was released to Nellis AFB for Tactical Air Command Operational Test and Evaluation (TAC OT&E) and to St. Louis for production acceptance flights. Problems in the Phase I tape were identified during OT&E and McAir production acceptance flights. The tape was returned to DT&E. The problems were corrected and production incorporation of the Phase I tapes began in July 1984. ECP 1518 Phase II DT&E was completed at Edwards AFB. The Phase II tape has also completed OT&E and been released to the tactical forces.

(U) DT&E for ECP 1833 (FY 1985 Radar Tape) started in March 1985. However, due to higher priorities, only 75% of the original capabilities will be incorporated in Phase I. This tape was available to the field in June 1986.

(U) The Derivative Fighter DT&E test program which began in November 1982 was completed in May 1983. The Derivative Fighter Flight Test Program involved four aircraft and accomplished initial air-to-surface stores carriage/separation, F-15 performance and flying qualities with conformal fuel tanks (CFT) and air-to-surface stores, avionics integration including high resolution radar, rear cockpit evaluation, weapons delivery and an operational utility evaluation. Because of high angle-of-attack (AOA) problems with CFTs, additional flights were required. The follow-on CFT high AOA flight test program was completed in July 1983 and the 30 units AOA restriction on CFT equipped aircraft in the air-to-air configuration was removed. With this restriction eliminated, AFOTEC re-flew the Derivative Fighter Air-to-Air Operational Utility Evaluation at Nellis AFB during June 1983. Heavy gross weight taxi testing was completed in August 1983. Initial BRU-26 flight tests were accomplished during the Derivative Fighter Flight Test Program and are continuing under Seek Eagle. Limited flight testing of tangential weapons carriage on CFTs was completed during August 1983. Verification of a significant drag reduction compared to the BRU-26 rack was accomplished.

(U) On 4 Apr 1985, aircraft 84-0042 (D-50) arrived at Eglin AFB, Florida to begin F-15/Advanced Medium Range Air-to-Air Missile (AMRAAM) integration testing. Twelve flights were flown. The initial objective of establishing a baseline for the Multi-Staged Improvement Program (MSIP) F-15 avionics system was successfully accomplished. Unfortunately, D-50 crashed in December 1985. This set-back considerably delayed the F-15/AMRAAM integration program. Eglin AFB requested and received another MSIP configured F-15 (aircraft 84-0018). This aircraft completed modification and checkout in August 1986. The present AMRAAM schedule calls for Full Scale Development to continue through April

1988. Using data from the FSD program, an F-15/AMRAAM Radar Operational Flight Program (OFP) will be developed by Warner-Robins Air Logistics Center at Edwards AFB, CA. This tape will be available by F-15/AMRAAM IOC now scheduled for April 1989.

(U) The F-15E test program began in January 1985 with Low Altitude Navigation and Targeting Infrared System for Night (LANTIRN) loads wind tunnel testing at Arnold Engineering Development Center (AEDC). The first Conformal Fuel Tank (CFT) Tangential Carriage loads testing began in October 1985. The AGM-65 (Maverick) and B-61 (nuclear) wind tunnel tests were completed in August 1986. F-15E Seek Eagle wind tunnel tests are scheduled for November 1986. The Phase I stores separation flight test was completed in May 1986. The purpose of this test was to evaluate store separation from the upper row, tangential carriage position of the -4 CFT (prototype). Phase II stores separation flight tests from the lower row are scheduled for April 1987.

(U) Air Force Development Test and Evaluation (AFDT&E) Reports

1. May 1975, AFFTC-TR-75-6, AFPE of the F-15 TEWS System
2. January 1976, AFFTC-TR-75-32, F-15A Approach-To-Stall/Stall/Post-Stall Evaluation
3. July 1976, AFFTC-TR-76-24, F-15 AFDT&E of Armament/Weapons Delivery System
4. July 1977, AFFTC-TR-76-48, F/TF-15A Flying Qualities, AFDT&E
5. July 1977, AFFTC-TR-77-7, F-15 Performance AFDT&E
6. August 1977, AFFTC-TR-77-4, F-15 AFDT&E TEWS Evaluation
7. 6 September 1977, Air Intercept Evaluation (AIMVAL) Vol I-VI by Rear Admiral Ernest E. Tissot, USN, and Major General James R. Hildreth, USAF.
8. February 1978, ACEVAL/AIMVAL Joint Test Force, Nellis AFB Vol I-IV by Rear Admiral Robert P. McKenzie, USN, and Major General James R. Hildreth, USAF
9. 1 April 1978, AFFTC-TR-77-40, F-15 AFDT&E Air-to-Air Missile Evaluation (AIM-9L)
10. 10 May 1978, JFS Air Start Report AFFTC Directive 78-129
11. November 1979, AFFTC-TR-79-21, F-15 APG-63 Radar, Hardware/Software Improvements
12. December 1979, F-15 AFDT&E TEWS Phase III, AD-TR-79-84
13. November 1980, AFFTC-TR-80-23, F-15C Flying Qualities, AFDT&E
14. March 1981, Tape 066 OFP Verification AD-TR-77-4 (ALR-56)
15. September 1981, AFFTC-TR-81-18, F-15 Limited Takeoff and Landing Evaluation
16. CIP Task 005, F-15/F-16 Flight Test (Engine)
17. August 1986, AEDC TSR-86-P17, Wind Tunnel Aerodynamic Separation Characteristics of MK-20 and GBU-12 stores from the F-15 aircraft.
18. December 1985, AEDC TSR-85-P23, Wind Tunnel Separation Characteristics of F-15E stores from Conformal Fuel Tanks.

Budget Activity: 4, Tactical Programs
Program Element: 27130F, F-15 Squadrons

19. February 1986, AEDC TMR-85-P22, Analysis of Separation Trajectories of F-15E stores from Conformal Fuel Tanks.
20. August 1986, AEDC TSR-86-P13, Wind Tunnel Aerodynamic Separation Characteristics of AGM-65 Maverick Missiles from F-15E aircraft.

(U) Contractor Development Test and Evaluation (CDT&E) Reports

1. 9 November 1971, MDC A-1429, Static Test Results, Final Report
2. 6 March 1972, MDC A-1595 F-15 Full Scale Inlet/Engine Compatibility Test
3. 7 March 1972, MDC A-1601, F-15 Structural Utilization Report
4. 16 March 1972, MDC A-1617, Milestone VIII, F-15 Avionics Integration Test Status
5. 28 April 1972, MDC A-1688, Results of Fatigue/Static Test of F-15 Preproduction Design Verification (PDV-1) Wing Carry Through
6. 2 August 1972, MDC A-1865, Final Report Propulsion Subsystem Endurance (pit 4 F100 PW100 engine test)
7. January 1973, MDC A-2104, F-15 Demonstration Milestone 10, Documentation Report - Initial Airborne Avionics Performance
8. 27 February 1973, MDC A-2198, VOL I-VIII, F-15 Fatigue Tests-FTA 1 for fuselage and Cockpit Fatigue Test
9. 5 January 1979, MDC A-5736, Test Program, JFS Air Start Capability in USAF airplanes, Flight Test Program, St. Louis, MO.
10. 25 July 1979, MDC A-6084, F-15C Final flight Test Report
11. 9 November 1981, MDC A-7436, Version Description Document (Computer Program for F-15 Indicator Group) (PSDP-Operational Flight Program)
12. 20 Aug 86, MDC-A-9891 Birdstrike Resistant Windshield Element Fatigue Test Final Report
13. 03 Apr 85, MDC-A9085 F-15E Windshield Strain Survey Birdstrike Tests
14. 21 May 85, MDC-A9128 Element Fatigue & Material Characterization Test on F-15E Wing Area

2. (U) Operational Test and Evaluation (OT&E): Initial Operational Test and Evaluation (IOT&E): The F-15 IOT&E was part of a combined IOT&E/Air Force and contractor Development Test and Evaluation (DT&E) conducted at Edwards AFB, California, using data from contractor and Air Force DT&E sorties flown July 1972 through 30 June 1975. The IOT&E was USAF directed, Tactical Air Command conducted, and Air Force Test and Evaluation Center (AFTEC) monitored. The IOT&E provided estimates of system operational effectiveness and suitability in support of Defense Systems Acquisition Review Council (DSARC) decisions related to increased production rate. Specific test objectives addressed both air-to-air and air-to-ground mission roles. In the 2.5 year effort 4460 sorties were flown. The aircraft was found to have superior handling and flight characteristics in the air-to-air regime. Likewise the F-15 was shown to be an effective platform for air-to-ground ordnance delivery. The continual change of hardware and software throughout the test program precluded establishment of a reliability assessment data base. The immaturity of built-in test (BIT) and the absence of major test equipment items were limiting factors in the overall suitability evaluations.

Budget Activity: 4, Tactical Programs
Program Element: 27130F, F-15 Squadrons

(U) Follow-on Operational Test and Evaluation (FOT&E): The F-15 FOT&E was an independent test and evaluation managed by the AFTEC and conducted by the AFTEC test team at Luke AFB, AZ. The objectives of FOT&E were to verify the operational effectiveness and suitability, which included assessment of the logistics supportability, life cycle costs, and identification of desirable modifications or trade-offs for the production F-15 system. The FOT&E commenced in March 1975 and finished in July 1976 using a total of 1111 F-15 sorties and approximately 900 support sorties. Evaluation sorties were flown by AFTEC and Tactical Air Command pilots. Once again, the F-15 was found to be an excellent weapons system for air-to-air combat. Several deficiencies were noted, but the F-15 Program Office has since corrected them. Test estimates of reliability/maintainability indicated that the F-15A will be malfunction free on 20 percent of the sorties and generally have the capability to turn for a second mission 50 percent of the time. The manpower requirements necessary to support a 72 aircraft wing were estimated at approximately 1000 authorizations.

(U) In addition to the above testing, an IOT&E of the F-15 Tactical Electronic Warfare System (TEWS) was conducted by the US Air Force Tactical Air Warfare Center (USAF TAWC), Eglin AFB, Florida. TEWS gives the fighter pilot an EW capability far superior to that of previous EW systems. The resources of the Armament Development and Test Center, the Naval Weapons Center, and the 6512 Test Squadron, Air Force Systems Command were used during the test. The test was conducted simultaneously with Air Force and contractor Development Test and Evaluation (DT&E) from February 1974 through October 1976. The IOT&E, which was Air Force directed and Air Force Test and Evaluation Center monitored, was comprised of 325 sorties. Air Force personnel performed organizational level maintenance for the F-15 TEWS. However, intermediate and depot maintenance support was accomplished entirely by contractor engineers and technicians using interim special test equipment.

(U) An IOT&E of the Overload Warning System (OWS) was conducted by the US Air Force Tactical Fighter Weapons Center (USAFTFWC), Nellis AFB, Nevada. The OWS should reduce F-15 air frame damage resulting from flight overload situations as well as permitting more effective employment of the F-15. The OWS IOT&E report was released in March 1981. Production incorporation began with the FY 1980 buy, and the first aircraft was delivered in December 1981.

(U) The Air Force Operational Test and Evaluation Center (AFOTEC) participated in a combined DT&E/Operational Utility Evaluation (OUE) of the F-15 dual-role fighter (DRF) from August 1982 through April 1983 at Edwards AFB, California. AFOTEC testing emphasized air-to-surface mission capabilities. Effectiveness data were collected on 49 dedicated OUE sorties. Suitability data were collected on 151 combined DT&E/OUE sorties. The prototype F-15 DRF demonstrated a significant improvement over the F-15 aircraft baseline in range and payload for all configurations flown. Performance and handling, in both air-to-surface and air-to-air combat operations, were equal to or better than the baseline when the conformal fuel tanks were empty. The F-15 DRF could be flown effectively at its maximum gross weights and configurations, but predictably, its maneuverability was slightly degraded. Overall, the aircraft has improved air-to-surface operational capabilities while retaining its basic air superiority capability.

Budget Activity: 4, Tactical Programs
Program Element: 27130F, F-15 Squadrons

(U) The F-15 Multi-Staged Improvement Program (MSIP) Operational Test and Evaluation (OT&E) Phase I began in August 1985. The purpose is to evaluate the operational effectiveness and suitability of the F-15 MSIP air-to-air hardware and software. Phase I testing will consist of air-to-air intercepts against multiple targets, live fire of AIM-7 and AIM-9 missiles, Goldenbird sorties and Radar Test Facility testing at Tyndall AFB, Florida. Live fire missions will be flown at the Eglin Gulf Test Range. Approximately 42 sorties will be flown by US Air Force Tactical Air Warfare Center using F-15 MSIP aircraft from the 33TFW, Eglin AFB, Florida.

(U) Combined DT&E/OT&E will be conducted on the F-15E. AFOTEC will conduct the OT&E which will occur primarily at Edwards AFB CA. Deployments to Eglin AFB FL, Holloman AFB NM, and McChord AFB WA are planned; their purpose will be to encounter terrain and weather that are more representative of the planned theaters of operation and to conduct air-to-air missile firings. OT&E objectives have been fully integrated with DT&E objectives to shorten the schedule and reduce the cost. Data collected during DT&E missions should lower the number of dedicated OT&E sorties to 150. Test scenarios are being structured to accommodate the objectives of the combined test program and to answer the four critical operational issues:

(1) Will the F-15E be capable of night, under-weather air interdiction and offensive counter air in a combat environment?
(2) Will the F-15E retain the F-15C/D MSIP's basic air defense capability?
(3) Will the F-15E be sufficiently available to fulfill operational requirements?
(4) Will the F-15E weapon system be capable of performing its designated missions without essential subsystem failures that would result in unacceptable mission degradation?

The AFOTEC Test Team will include personnel from TAC, AFLC, ATC, and MAC (Air Weather Service). The first increment of the AFOTEC Test Team will complete all required prerequisite training and report to Edwards AFB in June 1987. A second increment will report in October 1987. The final increment will report in March 1988. A report will be published prior to IOC; it will be based on testing through March 1989. Dedicated OT&E missions will be conducted using two production aircraft, operational crews, and USAF maintenance. The ability to do meaningful testing in a threat environment will be limited by the fact that the ALQ-135 Band 1.5 will still be in development during this test. Lack of a full up Mobile Electronic Test Set (METS) will make it difficult to estimate suitability values that depend on intermediate level maintenance. The requirement to share a limited number of production LANTIRN pods will require cooperation and close coordination in order to prevent the schedule from being adversely affected.

(U) Operational Test and Evaluation (OT&E) Reports

1. F-15 Initial OT&E Final Report, January 1976 (U)
2. F-15A Follow On OT&E Final Report, August 1976 (U)

Budget Activity: 4, Tactical Programs
Program Element: 27130F, F-15 Squadrons

3. F-15 TEWS IOT&E Final Report, January 1977 (U)
4. F-15 Verification T&E in Europe, July 1977 (U)
5. F-15 Tactical Electronic Warning System, December 1979 (U)
6. F-15 Overload Warning System, March 1981 (U)
7. F-15 Improved Radar QOT&E Final Report, July 1981 (U)
8. F-15 DRF OUE Final Report, November 1983 (S)

9. (U) Systems Characteristics: The F-15 is an advanced tactical fighter developed for the air superiority mission. It is a twin engine, single place, fixed swept wing airplane characterized by high thrust-to-weight and low wing loading for superior acceleration and maneuverability. The F-15 is equipped with a balanced mix of air-to-air weapons ranging from medium range all-weather missiles to rapid-fire 20mm cannon and provides an outstanding capability against the postulated enemy air threat.

A. (U) Operational	DEVELOPMENT ESTIMATE	DEMONSTRATED PERFORMANCE
1. (U) Max Mach No @ Altitude (Sustained/Burst)	2.3/2.5	2.3/2.5
2. (U) Max Mach No @ Sea Level (Sustained)	1.2	1.16
3. (U) Design Maximum Load Factor (80% Internal Fuel), g	7.33	7.33
4. Maximum Buffet-Free Maneuver g (0.8M, 30K ft), g		
5. (U) Energy Maneuverability (Ps), fps		
a. ( ) 0.9M, 30,000 ft, 5g, Mil Pwr		
b. ( ) 0.6M, 10,000 ft, 5g, Max Pwr		
c. ( ) 0.9M, 10,000 ft, 1g, Max Pwr		
d. ( ) 0.9M, 10,000 ft, 5g, Max Pwr		
e. ( ) 0.9M, 30,000 ft, 5g, Max Pwr		
f. ( ) 0.9M, 35,000 ft, 5g, Max Pwr		

Budget Activity: 4, Tactical Programs
Program Element: 27130F, F-15 Squadrons

B. (U) Technical

	DEVELOPMENT ESTIMATE	DEMONSTRATED PERFORMANCE
1. Design Mission Takeoff Wt, lb	40,000	41,491
2. Takeoff Wing Loading, lb/ft	66	68
3. Un-installed Thrust-to-Takeoff Weight Ratio	1.17	1.15

Budget Activity: 4, Tactical Programs
Program Element: 27130F, F-15 Squadrons

4. (U) Current Test and Evaluation (T&E):

Event	T&E Activity (Past 12 Months) Planned Date	Actual Date	Remarks
ALQ-135 Flight Test	Feb 1986	Jun 1986	
Phase II F-15E Stores Separation WTT	May 1986	May 1986	
F-15E/Maverick Missile Separation WTT	May 1986	May 1986	
Phase I Stores Separation Flight Test	May 1986	May 1986	
F-15E/Maverick/B-61 Loads WTT	Jul 1986	Jul 1986	
F-15E Seek Eagle WTT	Nov 1986	Nov 1986	
F-15E Flight Test	Dec 1986	Dec 1986	Combined DT&E

Event	T&E Activity (Next 12 Months) Planned Date	Remarks
Phase II Stores Separation Flight Test	Apr 1987	
Digital FLT CTL Evaluation	2Q FY87	TAC F-15C/D Pilots
MSIP Radar Flight Test (APG-70 Hardware)	Through 19 Sep 1987	Ongoing
MSIP/AMRAAM Investigation Flight Test	Through Apr 1988	Ongoing

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 27133F
DOD Mission Area: 223 - Close Air Support and Interdiction
Title: F-16 Squadrons
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		61,108	54,872	36,486	23,640	92,637	1,481,431
2671	F-16A-D	61,108	54,872	36,486	23,640	92,637	1,481,431

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program satisfies the mission need for a high performance, multimission fighter capable of performing a broad spectrum of tactical air warfare tasks at an affordable cost. The F-16 is designed for high sortie rates with rapid turnaround, minimum manpower and logistics burden, and exceptional air combat maneuvering performance coupled with a potent air-to-surface weapons delivery capability. The F-16 is replacing aging F-4s in the active inventory as well as modernizing the Reserve Forces.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	66,270	81,323	42,718	N/A	89,989	1,492,300
Aircraft Procurement	3,219,000	3,842,600	3,932,100	N/A	25,812,400	52,890,600

EXPLANATION: (U) RDT&E - In FY 1986 $3.62 million was added for the integration of High Speed Antiradiation Missile (HARM) and $7.6 million was reduced for the effects of Gramm-Rudman and other recissions. Project 2970, Precision Location Strike System/Adaptive Targeting Data Link (PLSS/ATDL), has been cancelled with a reduction of $15.9 million in FY 1987 and $4.8 million in FY 1988. An additional reduction of $7.7 million in FY 1987 sources a higher priority Air Force program. In FY 1988, the AMRAAM and Robust Countermeasures programs have been extended, and funding has been added for HARM integration while ECCM software development has been revised. PROCUREMENT - The reduction to FY 1986 is due primarily to delays in initiating the Airborne Self-Protection Jammer (ASPJ) production verification buy, deferring operational flight trainers, and cost reduction initiatives. In FY 1987 through FY 1991, planned procurement quantities have been reduced from 216 to 180 aircraft per year. Additional savings were also realized through engine repricing.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

Aircraft Procurement:						
Funds	2,908,395	2,951,908	2,885,168	3,416,667	18,039,800	46,047,300
Quantities	180	180	180	180	870	2729

5. (U) RELATED ACTIVITIES: The following program elements contain development efforts which are applicable to the F-16: PE 64314F/27163F, Advanced Medium Range Air-to-Air Missile; PE 63249F, Night Attack Program; PE 64249F, Night/Precision Attack (Low Altitude Navigation and Targeting Infrared System for Night); PE 35164F, Navstar Global Positioning System (GPS); PE 64725F, Aircraft Identification System (Combat Identification System); PE 64201F, Aircraft Avionics Equipment Development; PE 64218F, Engine Model Derivative Program; PE 64737F, Airborne Self-Protection Jammer; PE 64268F, Aircraft Engine Component Improvement Program; PE 64223F, Alternate Fighter Engine; and PE 63742F, Combat Identification Technology.

6. (U) WORK PERFORMED BY: The F-16 System Program Office of the Aeronautical Systems Division (ASD), Wright-Patterson Air Force Base, OH, has management responsibility for the F-16C/D program as well as residual development tasks identified for the F-16A/B program. The F-16 System Program Management Division of the Ogden Air Logistics Center, Materiel Management Directorate, Hill AFB, UT, has management responsibility for the F-16A/B program, with the exception of residual tasks retained by ASD under the Program Management Responsibility Transfer agreement. The major contractors are General Dynamics, Fort Worth, TX (F-16 airframe); Pratt & Whitney, East Hartford, CT and General Electric, Evandale, OH (engine); and Westinghouse, Baltimore, MD (radar). In addition to these, there are over 4,000 other subcontractors and suppliers in the United States. Major European manufacturers include Fabrique Nationale, Belgium (engine); SABCA/SONACA, Belgium (aft fuselage, wings and assembly); FOKKER, The Netherlands (center fuselage and assembly); DAF, The Netherlands (landing gear); Per Udsen, Denmark (pylons and vertical fin); Kongsberg Vapenfabrikk, Norway (inertial navigation set and fan drive module); and General Electric Corporation, England (head-up display).

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2671, F-16A-D

A. (U) Project Description: This project has developed the F-16 aircraft from its origin in the Lightweight Fighter Prototype Program in the early 1970s to the fighter aircraft currently being produced and deployed in these tactical air forces: Tactical Air Command, United States Air Forces Europe, Pacific Air Forces, Air Force Reserve, Air National Guard, and the air forces of nine other countries around the world. In addition, sales agreements have been signed with four more countries. Engineering flight test provides continued evaluation for the airframe, engine, aircraft subsystems and stores certification; a development effort also adds increased F-16 capability to meet the large quantitive and expanding qualitative threat. Efforts currently underway include radar improvements required for use of radar missiles and enhanced electronic counter-countermeasures, the integration of the Advanced Medium Range Air-to-Air missile (AMRAAM), development of an Automatic Terrain Avoidance (Auto TA) capability to be used in conjunction with the Low Altitude Navigation and Targeting Infrared for Night (LANTIRN) system, and development of an F-16 combat identification capability for the employment of beyond visual range missiles.

B. (U) Program Accomplishments and Future Efforts:

Program Element: 27133F — Title: F-16 Squadrons
DOD Mission Area: 223 - Close Air Support and Interdiction — Budget Activity: 4 - Tactical Programs

(1) (U) FY 1986 Accomplishments: The FY 1986 RDT&E funds were used for mission support, to continue support of follow-on test requirements for equipment upgrades and identified deficiencies, and to continue development of previously initiated efforts. Development continued on the All Environment Identification system, a Mark XII system with interrogator and transponder capability. This identification friend or foe capability is required to take full advantage of beyond visual range missile capability. Development continued on Adaptive Targeting Data Link (ATDL), and Advanced Medium Range Air-to-Air Missile (AMRAAM) integration continued with production incorporation of full AMRAAM capability scheduled for February 1987. Efforts continued in the development and integration of robust countermeasure techniques and the development of an Operational Capability Upgrade (OCU) modification kit for Block 15 F-16A/Bs. The OCU program will add expanded memory and increased input/output capability to the embedded computers and a data link to the APG-66 radar to allow future growth in the capabilities of these aircraft. This upgrade will allow employment of new weapons such as AMRAAM and will baseline a common aircraft configuration with our European partners. Development continued on the Auto Terrain Avoidance system to complement the Low Altitude Navigation and Targeting Infrared for Night (LANTIRN) system. Development began on the preplanned product improvement avionics upgrade for the Block 70 aircraft and the integration of the Shrike and High Speed Anti-Radiation (HARM) missiles.

(2) (U) FY 1987 Program: The FY 1987 RDT&E will continue to fund the follow-on engineering and test support and mission support for the F-16 System Program Office. This effort includes laboratory support, Air Force Operational Test and Evaluation Center support, computer support, and Seek Eagle stores certification activities. In addition, development efforts initiated in prior years will be completed for incorporation into the F-16. Expanded memory capabilities are being provided to the APG-66 radar to enhance ECCM; and software upgrades are being integrated into the expanded F-16A/B processors for enhanced operability and added capabilities required by the user. Development will be completed on the Auto TA system in conjunction with a digital flight control system which combines with the LANTIRN system to provide a night, under-the-weather mission capability. Development will continue on robust electronic countermeasures (ECM), Shrike and HARM missile integration, and an electronic counter-countermeasure capability which will enable the APG-68 radar to neutralize efforts to jam its operation.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The FY 1988 RDT&E program continues the efforts described in FY 1987 for follow-on engineering, test support, and Seek Eagle certification to include the Shrike and HARM missiles, and mission support for the F-16 System Program Office. The All Environment Identification system continues development work on a combined interrogator/transponder and multi-sensor integration that can synthesize identification information from a number of sensors. Development also continues on robust ECM, the electronic counter-countermeasure capability for the APG-68 radar and HARM/Shrike integration. Development is completed on several subsystems including the LANTIRN system, Global Positioning System, digital flight controls and the AMRAAM. An advanced radar warning receiver and chaff and flare dispenser continue in development for full incorporation in future F-16 aircraft.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The FY 1989 RDT&E Program continues the efforts of the Program Office and test organization to develop improved avionics to meet the evolving threat of the 1990s. This includes follow-on engineering support, test support, Seek Eagle certification and mission support of the F-16 Program Office. Effort continues to improve the beyond visual range identification capability of the All

Environment Identification system through preplanned product improvement capabilities for the electronic countermeasure system. Effort continues to integrate increased performance derivatives of the current F-16 F-110-GE-100 and F-100-PW-220 engines starting with the FY 1990 aircraft procurement. Development an Integration of HARM/Shrike is completed.

(5) (U) Program to Completion: This is a continuing program. Funding for follow-on test and engineering, as well as program office mission support, will continue. Continued development effort will complete the advanced Mark XII Identification system. Avionics upgrade will continue throughout this period in order to meet the increasing capabilities of the threat in the 1990s. Finally, the radar electronic counter-countermeasure system will complete development and test.

C. (U) Major Milestones:

	Milestones		Date
(1) (U)	Source Selection and Award of Development Contract		January 1975
(2) (U)	Defense Systems Acquisition Review Council (DSARC) II		March 1975
(3) (U)	European Long Lead Funds Released		June 1976
(4) (U)	Delivery First Full-Scale Development Aircraft		December 1976
(5) (U)	DSARC IIIA (Long Lead Release)		January 1977
(6) (U)	DSARC IIIB (Production)		October 1977
(7) (U)	First Aircraft to Tactical Air Command		January 1979
(8) (U)	First European Aircraft		January 1979
(9) (U)	Initial Operational Capability		October 1980
(10) (U)	Delivery of 651st Aircraft		September 1983
(11) (U)	Initial Delivery of the F-16C		July 1984
(12) (U)	Program Management Responsibility Transfer F-16A/B to AFLC		October 1985
(13) (U)	Delivery of Last F-16	* (May 1996)	May 1997

* Date presented in FY 1987 Descriptive summary.

(U) Explanation of Milestone Change:

(12) (U) Delivery has been extended one year with the addition of aircraft procurement in FY 1995.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

Budget Activity: 4, Tactical Programs
Program Element: 27133F, F-16 Squadrons

Test and Evaluation Data

1. (U) Development Test and Evaluation (DT&E): General Dynamics is the prime contractor for airframe and support equipment development and Pratt & Whitney is responsible for continued development of the F100 engine. The General Electric F110 engine will be introduced in production in 1986. Most of the major development testing on the basic aircraft, subsystems, and support equipment have been completed. Performance and stability and control testing indicate that the aircraft can meet design specifications and be employed effectively throughout the flight envelope. The F-16 has demonstrated that it can carry and employ a varied mix of weapons including air-to-air ordnance, air-to-surface guided missiles, conventional bombs, and nuclear weapons. The F-16 radar meets basic specifications and can be used effectively to deliver air-to-air and air-to-ground weapons. Ground testing results indicate an airframe life of at least 8,000 hours. As would be expected in any development program, there have been changes required to correct problems identified during the test program. Fixes have been designed, tested, and incorporated into the production aircraft. The last of the development aircraft was delivered in August 1978 and the first F-16 unit was activated at Hill Air Force Base, UT, in January 1979. All weather testing in desert and tropical climates is completed. Alaskan cold weather tests and an evaluation in European weather conditions were completed in early 1979. Testing to evaluate engine inlet icing problems was initiated in 1979 and verified the value of the heated inlet strut and engine anti-ice improvements.

(U) Future flight tests will include certification of additional weapons, continued systems integration tests, and evaluation of fixes for previously identified deficiencies. The major test activity in follow-on development will be evaluation of the enhancement of aircraft systems necessitated by threat evolution. Reliability and Maintainability (R&M) testing has been an integral part of the development effort and the F-16 current experience indicates it can meet R&M goals established at program approval.

(U) There were originally eight full scale development aircraft and a decision was made in 1980 to authorize 11 production aircraft to upgrade the F-16 test fleet. Of the original eight aircraft, three have been decommissioned, one has been leased to General Dynamics for the F-16/J79 program, one is assigned to the Advanced Fighter Technology Integration program, two have been modified under the General Dynamics Independent Research and Development program to the F-16XL configuration, and one is still being used at the Air Force Flight Test Center for follow-on testing.

(U) The two F-16XL aircraft were at Edwards AFB through FY 1985 for the flight evaluation of the F110 engine, a large modular inlet duct, leading edge flaps, and an advanced flight control system. Of the 21 production aircraft in the test fleet, ten are assigned to Eglin AFB for Advanced Medium Range Air-to-Air Missile, SEEK EAGLE, and other weapons development testing. Eleven are assigned to Edwards AFB for follow-on testing and Multinational Staged Improvement Program integration to include the APG-68 radar and F110 engine. One production aircraft was attrited in a Class A accident. This test force was augmented with up to eight additional operational aircraft which are being used to support Low Altitude Navigation and Targeting Infrared for Night, Global Positioning System, Airborne Self-Protection Jammer, and ALR-74 DT&E and initial operational test and evaluation efforts.

617

(U) Over the next year the major test efforts will be in support of the F110 engine, APG-68 radar improvements and integration of the other Multinational Staged Improvement Program avionics (Block 30, February 1987) in addition to the normal follow-on testing and weapons certification. Testing in support of the growth subsystems being added to the F-16 includes the Advanced Medium Range Air-to-Air Missile, Low Altitude Navigation and Targeting Infrared for Night, Airborne Self-Protection Jammer, and Global Positioning System. These tests will continue to grow as the subsystems near their production effectivity.

2. (U) Operational Test and Evaluation (OT&E): The F-16A/B initial operational test and evaluation (IOT&E) was conducted in conjunction with development test and evaluation (DT&E) from December 1976 to October 1977. The IOT&E results reported in the Air Combat Fighter IOT&E Final Report, January 1978, US Government distribution, supported a production recommendation to the Defense Systems Acquisition Review Council IIIB. Follow-on operational test and evaluation (FOT&E), Phase I, was completed in January 1979 and reported in the F-16 (A/B) FOT&E Final Report, Phase I, June 1979, US Government distribution.

(U) The purpose of the OT&E was to evaluate the operational suitability and effectiveness of the F-16A/B weapon system. The radar/head-up display/fire-control system interface was evaluated in air-to-air missions against projected simulated threat aircraft and in air-to-surface attack missions. Air-to-air weapons such as the AIM-9 and M61 gun were fired at realistic maneuvering targets. Day and night evaluation of the F-16A/B air refueling capability was accomplished. The F-16A/B's performance and handling characteristics were qualitatively and quantitatively evaluated while performing basic fighter maneuvers and air combat maneuvers against current and projected simulated threat aircraft. The electronic countermeasures capability and electromagnetic interference susceptibility of the F-16A/B were evaluated. In addition, the operational suitability evaluation included the following: reliability and maintainability to include maintenance support factors, potential maintenance safety hazards, and determination of training requirements and operating and support costs.

(U) This F-16A/B combined DT&E/IOT&E was conducted primarily at Edwards AFB, California. Other test sites were Nellis AFB, Nevada; China Lake NWC, California; Alaska; El Centro NAS, California; Yuma MCAS, Arizona; Panama, Canal Zone; and Eglin AFB, Florida. An Air Force Operational Test and Evaluation Center (AFOTEC) test team composed of personnel from AFOTEC, Tactical Air Command (TAC), Air Force Logistics Command, and Air Training Command conducted the OT&E portion of the combined tests. Additionally, a combined Air Force Systems Command/AFOTEC European test and evaluation with three aircraft was conducted from February to May 1979. Test sites included Bodo AB, Norway; Skrydstrup AB, Denmark; Hahn AB, Germany; and Alconbury AB, United Kingdom. Test resources were incrementally increased to a total of 11 aircraft of which eight were preproduction aircraft and three were production.

(U) FOT&E Phase II was conducted at Hill AFB, Utah, and in Europe from January 1979 through December 1980. TAC was responsible for operational effectiveness, and AFOTEC further evaluated operational suitability. The AFOTEC assessment included reliability and maintainability data generated by all F-16A/B aircraft assigned to Hill AFB, Utah.

(U) F-16A/B operational suitability, as reported in the F-16 Operational Suitability Test and Evaluation, Phase II Final Report, October 1980 was overall satisfactory during part I multinational operational test and evaluation (MOT&E). Weapon system reliability was highly satisfactory with cumulative MTBM for inherent failures and total corrective mean

time between maintenance (MTBM) at 1.42 and .47 hours, respectively. Mission reliability continued to exceed the goal of 90 percent through the last 8 months of the evaluation. Maintainability was satisfactory, although improvement was need in certain areas. Cumulative maintenance man-hours per flying hour (MMH/FH) (35) steadily declined throughout the OT&E to an end value of 29 MMH/FH. However, concerns existed about combat quickturn safety, limited onboard avionics self-test/built-in test (ST/BIT) capability, and immaturity of the avionics intermediate shop/automatic test equipment. By the end of the evaluation, various program efforts had been established to address these concerns. Availability was highly satisfactory with the mission capable rate stabilizing at 70 to 74 percent. Logistic supportability was satisfactory; however, adequacy of funding levels for war readiness spares kits (WRSK), F-100 engine support, and weapon system spare parts will continue to be critical to F-16A/B supportability in the outyears.

(U) F-16A/B follow-on operational test and evaluation (FOT&E)/tactics development and evaluation (TD&E), Phase II, commenced during January 1979 at Hill AFB, Utah. This FOT&E/TD&E was conducted jointly by the Air Forces of Belgium, Denmark, the Netherlands, Norway, and the United States. FOT&E/TD&E Phase II, designated the multinational operational test and evaluation (MOT&E) consisted of two parts. Part I, conducted in the United States (Hill AFB) from January 1979 through June 1980, used test facilities and ranges at the following locations: Dugway/Wendover, Utah; White Sands Missile Range, New Mexico; and the Nellis Range complex in Nevada. Part II was conducted in Europe from locations within the countries of the European Participating Air Forces (EPAF) between July and December 1980. In both parts of the MOT&E program, a mix of USAF and EPAF production aircraft was used, with a maximum of ten F-16A/Bs used as test assets during Part I and seven F-16s during Part II. Tactical Air Command (TAC) was responsible for the operational effectiveness and tactics development objectives; the Air Force Operational Test and Evaluation Center (AFOTEC) was responsible for the suitability assessment.

(U) The purpose of the MOT&E was to refine estimates of F-16A/B operational effectiveness, assist in evaluation of configuration changes, develop tactics and operating concepts for F-16A/B employment, and assess the operational suitability of the aircraft. The TAC F-16 MOT&E Final Report and Tactics Manual were released in May 1981.

(U) AFOTEC flew 467 front seat and 98 back seat sorties during initial and follow-on test and evaluation (IOT&E/FOT&E). This included six months of testing on two near production-configured full-scale development (FSD) aircraft and seven aircraft-months on the first three production aircraft. Operational test and evaluation included beyond visual range missions with F-4 and T-38 aircraft; operational comparisons, basic flight maneuvering and air combat maneuvering with F-4E, F-5, A-37, and T-38 aircraft; night and day air-to-surface bombing and strafe; air-to-air gunnery against towed targets; and AIM-9M/L firings against BQM-34, PQM-102, and QH-50 drones. Overall weapons system performance and reliability and maintainability estimates were rated satisfactory.

(U) Reliability and maintainability (R&M) estimates indicated an overall satisfactory rating. The IOT&E/FOT&E assessments for late FSD and production aircraft projected satisfactory mean time between maintenance (MTBM) and maintenance man-hours per flying hour (MMH/FH) for the mature F-16A/B. Average F-16A/B MTBM (for inherent failures) of 0.87 hour compared very favorably with the F-4 and A-7D mature average of 1.0 at the end of FSD. F-16A/B MMH/FH of 35.7 nearly equaled the mature F-4's 35. Corrective actions to fix major discrepancies affecting reliability and maintainability (R&M) goals; i.e., chafing and routing of aircraft wiring, high rate of fuel leaks, and excessive fuel venting

due to heat expansion were incorporated and were evaluated as satisfactory during ET&E. Damage or loss in flight of nonmetallic panels is no longer a problem because of replacement with metal panels. Concerns remaining at the end of IOT&E/FOT&E included high could-not-duplicate rates for self-test/built-in test equipment; high repair times for environmental control, hydraulic/pneumatic, auxiliary power, flight control, and fuel systems; and supportability of the hydrazine emergency power unit. Further evaluation of these areas continued during MOT&E.

(U) MOT&E phase II (European) suitability results were highly satisfactory. Weapbn system reliability was exceptionally high with an mean time between maintenance (MTBM) of 2.22 hours for inherent failures. Mission reliability was excellent at 94 percent. Aircraft availability was slightly better than that of phase I with an overall mission capable rate of 79 percent. The maintenance man-hours per flying hour (MMH/FH) value of 3.76 could not be compared to USAF data because of substantial documentation differences between the USAF and the European Participating Air Forces (EPAF). With the exception of potential long-term impacts from aircraft corrosion caused by industrial pollution, F-16A/B operations in Europe did not produce significantly different conclusions from those drawn during phase I MOT&E.

(U) A combined Air Force Systems Command, Air Force Operational Test and Evaluation Command ET&E with three aircraft was conducted from February to May 1979. Test sites included Bodo AB, Norway; Skrydstrup AB, Denmark; Hahn AB, Germany; and Alconbury AB, United Kingdom. During the ET&E, the F-16A/B was used in a wide variety of realistic operational mission scenarios to provide an early assessment of its effectiveness and suitability when operated in its intended environment. One hundred forty-two sorties were flown for an effective sortie rate of 0.78 which was well above the planned rate of 0.50. As reported in the European Test and Evaluation Final Report Addendum F-16 FOT&E Phase I, November 1978, overall F-16A/B performance was highly satisfactory. Taxi, takeoff, and landing on icy surfaces presented no major problems. Operational effectiveness deficiencies noted during ET&E included the following:

(U) Engine icing during ground operations: At near freezing temperature, induction icing occurred when the engine ingested standing water. Although this creates the potential for engine damage, none was observed during the test. Pilot manual selection of anti-ice was incorporated while a heated intake strut and additional heat through thirteenth-stage compressor inlet guide vanes were changes planned for incorporation in late CY 1981.

(U) Inadequate lighting for night air refueling: Satisfactory solutions were identified with incorporation completed in late CY 1981.

(U) Fuel venting during air refueling: Problem attributed to fuel distribution. Adequacy of a redesigned fuel shuttle valve (ECP 478) in Block 10A aircraft is still being assessed by operational units. The discrepancy is still open.

(U) False radar targets: Caused by radar side lobes reflecting off the surface and a frequency instability in the main beam. Solutions have been tested, approved, and incorporated.

Budget Activity: 4, Tactical Programs
Program Element: 27133F, F-16 Squadrons

(U) Boresighting procedures have been improved, corrected canopy distortion algorithms and slant range corrections have been installed in the fire-control computer, and updated weapons separation effects have been included in the stores management system. Testing has demonstrated that these solutions meet specifications, and fixes are in the field.

(U) Fire control/navigation panel (FCNP) difficult to operate by pilot: Fixes have been tested, approved, and incorporated in production.

(U) F-16A/B reliability and maintainability during ET&E was satisfactory to excellent. Mean time between maintenance (inherent) was 1.39 hours, and maintenance man-hours per flying hour (MMH/FH) was 17.3. Aircraft flyable rate was excellent at 82 percent. This compares with the end FOT&E rate of 54 percent. Problems included low reliability of the radar digital signal processor and low-power radio frequency units and a high rate of could-not-duplicate avionics and electrical malfunction indications. A hydrazine spill resulted in recommendations for several procedural, hardware, and protective equipment improvements. Operations from five different NATO shelter types were satisfactory.

(U) The Air Force Operational Test and Evaluation Center (AFOTEC) participated in a combined DT&E/operational utility evaluation (OUE) of the F-16 dual role fighter (DRF) from July 1982 through April 1983 at Edwards AFB, California. The F-16 DRF is a significantly modified F-16 featuring a cranked arrow wing and slightly stretched fuselage. The modifications provide more avionics space, more fuel capacity, and semiconformal carriage of weapons. The purpose of AFOTEC's OUE was to provide performance data for comparison with the F-16A/B to support a derivative fighter full-scale development decision. The effectiveness evaluation concentrated on aerodynamic handling qualities, range/payload capabilities, and weapons delivery. AFOTEC testing emphasized air-to-surface mission capabilities. Effectiveness data were collected on 36 dedicated OUE sorties. Suitability data were collected on approximately 326 combined DT&E/OUE sorties.

(U) The F-16 dual role fighter (DRF) demonstrated an improved air-to-surface operational capability while retaining its basic air-to-air capability. The prototype F-16 DRF demonstrated improvements over the F-16A in maximum air-to-surface combat radius, performance, and handling qualities. It also exhibited an improved capability in theater air defense radius and loiter time. The F-16 DRF was similar to the F-16A in tactical ferry range, routine operations, and operational suitability. However, the F-16 DRF performance was inferior to the F-16A in 1 versus 1 within-visual-range air combat maneuvering.

(U) AFOTEC participated in F-16C/D combined DT&E/IOT&E from January 1983 through December 1984. In addition, AFOTEC conducted independent F-16C/D IOT&E from January to April 1985. This DT&E/IOT&E was to evaluate F-16 enhancements resulting from the F-16 multinational staged improvement program (MSIP). The MSIP consists of phased improvements in F-16 air-to-air and air-to-surface mission capabilities by incorporating new developments in weapons and sensors. Basic changes in the F-16C/D include an improved radar (AN/APG-68), improved cockpit displays, wide-angle head-up display (HUD), increased computer speed and capacity, and provisions for future incorporation of Advanced Medium Range Air-to-Air Missile (AMRAAM), Low Altitude Navigation and Targeting Infrared for Night (LANTIRN), Airborne Self Protection Jammer (ASPJ), Global Positioning System (GPS), and ALR-74.

Budget Activity: 4, Tactical Programs
Program Element: 27133F, F-16 Squadrons

(U) Air Force Operational Test and Evaluation Center (AFOTEC) conducted the independent F-16C/D IOT&E using two production F-16Cs. Test missions were flown from Edwards AFB, California, and Nellis AFB, Nevada. Test aircraft were maintained by Air Force System Command personnel. The AFOTEC test team consisted of personnel from AFOTEC, Tactical Air Command (TAC), Air Training Command (ATC), and Air Force Logistics Command (AFLC). The following operational effectiveness deficiencies were noted during the F-16C/D IOT&E:

Air-to-air operations were rated marginal.

Air-to-surface operations were satisfactory. Weapon delivery accuracy was better than requirements for all events except radar laydown.

(U) Radar performance has been improved by software updates, Block 5A and 5A updates, incorporated in FY 1986. Performance will be further improved by production incorporation and retrofit of Block 6A followed by Block 6B update beginning in February 1987. All software changes are validated by ongoing DT&E and OT&E.

(U) F-16C/D reliability and maintainability (R&M) were marginal primarily due to excessive failures of avionics particularly the AN/APG-68 radar, the standard Inertial Navigation System (INS), and the Head up Display (HUD) and tires. Reliability improvements resulting from qualification and production tests combined with spares and personnel management options should allow reliability and maintainability requirements to be met by early 1987. Two high priority programs, Falcon C and Falcon 50, have been implemented by the F-16 System Program Office (SPO) to improve F-16C/D system R&M. The Falcon C program continually assesses significant field-reported R&M problems and assigns teams to resolve them. Progress and results are reviewed at least monthly by the SPO Director. Falcon 50 is attacking unit repair turnaround times with its goal being a 50 percent reduction in current turnaround times. These programs, coupled with improvements resulting from qualification and production reliability testing since IOT&E, have resulted in the F-16C/D fully meeting or exceeding its reliablity & maintainability system maturity.

(U) Published OT&E reports include:

(1) F-16 A/B IOT&E Final Report, January 1978.
(2) F-16 A/B FOT&E Final Report, June 1979.
(3) F-16 A/B MOT&E Final Report and Tactics Manual, May 1981.
(4) F-16 DRF OUE Final Report, November 1983.
(5) F-16C/D IOT&E Final Report, June 1985.

3. (U) Systems Characteristics: (F-16A)

Budget Activity: 4, Tactical Programs
Program Element: 27133F, F-16 Squadrons

(U) Technical Information:

(U)	Length (ft)	49.5
(U)	Wing Span (w/missiles) (ft)	32.8
(U)	Operating Weight (empty) (lbs)	16,126
(U)	Internal Fuel (lbs)	6,972
(U)	Current Max Takeoff Gross Weight (lbs)	37,500
(U)	Max Payload w/Full Internal Fuel (lbs)	12,302
(U)	Engine Thrust (lbs)	23,759 (F100-PW-220) 24,750 (F110-GE-100, NSI); 27000 (F110-GE-100, MCID)

(U) Performance Thresholds: (F-16 Development Concept Paper)

		Threshold	Demonstrated
( )	Radius - Air Superiority Mission (NM)		
( )	Radius - Air-to-Surface Mission (NM)		
( )	Sustained Turn Rates 1.2 Mach/30,000 ft (°/sec)		
( )	1.2 Mach/30,000 ft (G)		
( )	0.9 Mach/30,000 ft (°/sec)		
( )	0.9 Mach/30,000 ft (G)		
( )	Acceleration Time		
( )	0.9-1.6 Mach/30,000 ft (sec)		
( )	Max Controllable G		
( )	0.8 Mach/40,000 ft (G)		
( )	Ferry Range (NM)	2200	2168

(U) Other Characteristics:

(U)	Takeoff Distance (Air-to-Air Mission) (ft)	N/A	2200
(U)	Landing Distance (ft) (estimated)	N/A	
(U)	Mission Reliability (%)	90	91
(U)	Mean Flight Time Between Failure (hrs)	2.90	3.05
(U)	Radar Detection Range, 2 sq meter Target (look up/look down) (Current APG-66)	24/18	24/18

Budget Activity: 4, Tactical Programs
Program Element: 27133F, F-16 Squadrons

4. (U) Current Test and Evaluation (T&E):

T&E Activity (Past 12 Months)

Event	Planned Activity	Actual Date	Remarks
F-16A/B Improvements	Continuing	Dec 76 to present	Continued testing for weapons certification and F-16A/B model improvements/correction of deficiencies for both airframe and engine hardware/Operational Capabilities Upgrade; ongoing at Edwards AFB and Eglin AFB.
F-16C/D (MSIP) DT&E	Continuing	Nov 82 to present	Structural, performance and avionics testing related to MSIP III (Block 30/30B) aircraft and F110 engine development ongoing at Edwards AFB.
F-16C/D FOT&E	Continuing	Jun 85 to present	

T&E Activity (Next 12 Months)

Event	Planned Date	Remarks
F-16A/B Improvements	Continuing	Continued F-16 testing related to system enhancements and Operational Capabilities Upgrade is scheduled.
F-16C/D (MSIP)	Continuing	MSIP III (Block 30/30B) integration testing ongoing at Edwards AFB.
F-16C/D MSIP Stage III (AMRAAM, ASPJ, LANTIRN, GPS, ALR-74) IOT&E	Jun 86 to Dec 88	Limited IOT&E planned through Block 30B (February 1987) with major test effort planned for the Block 40 (December 1988) aircraft. Each major subsystem incorporation date will depend on its development schedule.
F-16C/D FOT&E	Continuing	Tactical Air Command testing planned through September 1987.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 27136F
DOD Mission Area: 224 - Defense Suppression

Title: F-4G Wild Weasel Squadrons
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		36,931	35,333	17,762	17,001	Continuing	N/A
327B	F-4G Wild Weasel Squadrons	36,931	35,333	17,762	17,001	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The F-4G Wild Weasel is the only operational destructive defense suppression weapon system in the Air Force inventory. This system is specifically designed to automatically detect, identify, locate, engage, and destroy hostile radars. F-4G armaments consist of anti-radiation missiles, standoff guided munitions, and conventional F-4 weapons. The F-4G can be employed in the counter-air role as an escort for the penetration strike force, as an independent hunter-killer force, or as a standoff defense suppression force. The primary R&D effort is to update the capabilities of the F-4G so it can contend with the exotic threat radars being deployed now and through the 1990's. The original requirement for an advanced Wild Weasel aircraft was validated in FY 1968. The F-4G was developed and produced in response to this requirement. Initial Operational Capability was achieved on 1 April 1979. As threat signal complexity and density increased, the need to keep the Wild Weasel capable against the new threats was evident. The Performance Update Program for the F-4G Wild Weasel responds to this requirement. Funding has also been identified in FY 1987 ($2.6 Million) to conduct concept evaluations/risk reduction efforts to support a Follow-On Wild Weasel capability program. This study will determine the optimum approach to accomplishing the Wild Weasel portion of the Suppression of Enemy Air Defense mission.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	35,740	38,698	23,278	N/A	Continuing	N/A
Aircraft Procurement	0	0	104,200	N/A	314,600	471,300

EXPLANATION: (U) All RDT&E costs relate to Phase II (new receiver) of the F-4G Performance Update Program (PUP), which is now proceeding under a contract cost cap. The difference in FY 1986 reflects adjustments made to implement the cost cap and to align the aircraft test instrumentation schedule with the receiver development schedule. The changes in FY 1987 and beyond are due to a restructuring of the Phase II development program due to engineering problems identified in July and August of 1986. These development problems, plus a restructured flight test program (based on Phase I

testing experience) collectively delayed the program by approximately 20 months. The change in the production funding profile reflects the slips in the development program. The increase in estimated total cost is due to a more complete estimate of production and installation costs done in FY 87, and inflation adjustments due to the later deliveries. These production estimates include both the Phase I and II procurements; all initial spares; and modification of the four simulators. The spares and simulators, and Phase I kit buys for 18 F-4Es being converted to F-4Gs in FY 1988 were previously reported in other budget lines. Additional aircraft procurement funds for other F-4 modifications are not shown. Total quantity has changed because production of initial spares and support equipment for both Phase I and II, as well as the Phase I kits for F-4E to F-4G conversions, are included in this summary.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Aircraft Procurement:						
Funds	0	0	0	0	601,050	601,050
Quantities	0	0	0	0	124	274
Installation:						
Funds	0	0	0	0	13,300	13,300
Quantities	0	0	47	71	109	227

5. (U) RELATED ACTIVITIES: Air Force advanced and engineering development program elements (PE 63743F - Electronic Warfare Technology, PE 64738F - Protective Systems, PE 64739F - Tactical Protective Systems) developed the generic electronic combat technologies necessary to counter the advanced threat radars. The Imaging Infrared Maverick - PE 27313F and the High Speed Anti-Radiation Missile - PE 27162F are both being interfaced with the F-4G. A new inertial navigation system (ARN-101) is being installed by Air Force Logistics Command as a Class IV modification and will interface with the APR-38 Attack/Warning Receiver. The above programs are responsible for developing and funding the required interfaces for the F-4G/APR-38 system; however, this program element will ensure overall system capability/integration. Modification of the F-4G with performance updates developed in this program will begin in FY 1988.

6. (U) WORK PERFORMED BY: McDonnell Douglas, St Louis, MO, is the primary contractor for the F-4G Wild Weasel PUP. Subcontractors for the PUP are Sperry Univac, Minneapolis, MN; E-Systems, Garland, TX; and Micro Phase, Long Island, NY. Texas Instruments, Dallas, TX, builds the Memory Loader Verifier to upload and download the software into the APR-38. Singer-Link, Binghamton, NY, built, and still updates the F-4G simulator. Ogden Air Logistics Center, UT, is responsible for the management of F-4G enhancement programs. Air Force Systems Command, Andrews AFB, MD; Air Force Operational Test and Evaluation Center, Kirtland AFB, NM; and Tactical Air Command, Langley AFB, VA, are jointly responsible for testing of the F-4G. Air Force Systems Command is responsible for the subsystem and interface development of F-4G/APR-38 enhancements.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1987: Not Applicable.

Program Element: 27136F
DOD Mission Area: 224 - Defense Suppression

Title: F-4G Wild Weasel Squadrons
Budget Activity: 4 - Tactical Programs

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1987:

(U) Project: 327B, F-4G Wild Weasel Squadrons

A. Project Description: The APR-38 radar warning and attack system is the backbone of the F-4G Wild Weasel. Its current design is to counter the mid-1970's threat. For the F-4G to continue to be effective, the Air Force must update the APR-38 performance to more rapidly process enemy threat systems and cover a larger portion of the electromagnetic spectrum. The Performance Update Program (PUP) for the APR-38 will enable the F-4G to handle the 1990's threat by increasing the capacity of the onboard computer, expanding the frequency range, and increasing system processing speed to enable it to exploit increasingly complex radar signals in a denser signal environment. The update will also enable the F-4G to fully exploit the capabilities of the High Speed Anti-Radiation Missile. Proposed future updates to the APR-38 will include detection, identification and location of
and other advanced threats. All updates will also be incorporated into the flight simulators.

B. (U) Program Accomplishments and Future Efforts:

(1) FY 1986 Accomplishments: Phase I of the PUP (new computer with increased capacity and processing speed) continued Development Test and Evaluation and Initial Operational Test and Evaluation (IOT&E). Interim flight test results were good and supported a production decision in mid FY 1986. The Phase I production contract was signed in July 1986. Phase II (new receiver for expanded frequency coverage , and capability against the newer emitters and the denser signal environment) started system integration fabrication of the prototype units. These Phase II efforts had been delayed due to problems with vendor parts availability/delivery and receiver design miniaturization efforts.

(2) (U) FY 1987 Program: Phase I IOT&E was completed. The new computer developed in Phase I is in production. Phase II efforts continue on receiver/processor integration and support equipment modification. Phase II pre-production deliveries will begin by Mar 87 and fabrication of seven additional pre-production units will continue. Other Phase II-related tasks include: low frequency synthesizer delivery and completion of its airworthiness, environmental, and reliability qualification; completion of final system software design reviews; and the start of flight test aircraft modification. Additionally, a Follow-On Wild Weasel (FOWW) concept evaluation/trade off analysis study will be done. This study will look at the capabilities that will be required in the future to do the Suppression of Enemy Air Defense (SEAD) mission, evaluate alternatives, do risk reduction analysis, and recommend a FOWW solution.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Development of Phase I depot support equipment will begin. Phase II tasks include the fabrication and delivery of additional pre-production units and their acceptance testing; continuation of hardware/software integration; and delivery and acceptance of the electromagnetic environmental simulator (EES) at Warner-Robins Air Logistics Center. Phase II airworthiness testing will also begin. The RDT&E cost estimate is considered mature or Category II; the latest comprehensive update to these figures was in December 1986. Phase II production estimates are considered as planning estimates, or Category IV, and were updated in December 1986. Production estimates are based on a sole-source buy from the prime RDT&E contractor.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The remainder of the pre-production units will be delivered. Phase II airworthiness qualification will complete. Environmental qualification will be done, and reliability qualification testing will begin. Phase II of the Performance Update Program (PUP) will enter flight testing (Development Test and Evaluation and Initial Operational Test and Evaluation) starting in January. Phase II depot support equipment development will begin.

(5) (U) Program to Completion: Program consists of procurement and installation of the receiver/processor and other components in Phase II with an IOC in FY 1992. Full Operational Capability (FOC) for Phase II will terminate the current PUP effort. However, this is a continuing program. Future R&D efforts and/or modification programs for the F-4G will be funded through this program element as required.

C. (U) Major Milestones:

	Milestones		Dates
(1)	(U) PUP Contract Award		October 1982
(2)	(U) Phase I Efforts Initiated		October 1982
(3)	(U) Phase II Efforts Initiated		March 1983
(4)	(U) Phase I Production Contract Award		July 1986
(5)	(U) Phase II Flight Test Start	*(July 1987)	January 1989
(6)	(U) Phase I IOC	*(September 1987)	July 1988
(7)	(U) Phase II IOC	*(September 1990)	May 1992

*Date presented in Fiscal Year 1987 Descriptive Summary

(U) Explanation of Milestone Changes

(5) (U) Phase II flight tests slipped due to delay in deliveries of pre-production systems by E-Systems (as described above).

(6) (U) Phase I IOC slipped due to delays in getting a production proposal from McDonnell-Douglas, unexpectedly long negotiations between the SPO and McDonnell-Douglas to agree on a price, and added training requirements following delivery of production systems.

(7) (U) The aforementioned development problems delayed the IOC.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 27139F — Title: Air Defense Competition
DOD Mission Area: 122 - Strategic Air Defense — Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		0	0	3,525	2,846	2,083	8,454
3632	Air Defense Competition	0	0	3,525	2,846	2,083	8,454

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program funds the modification of F-16A aircraft for Strategic Air Defense. The mainstays of the Air Defense force, F-4 C/Ds and F-106s, are reaching the end of their useful life. Replacement aircraft are required to meet the air defense challenge of the 1990s. The newly modified Air Defense aircraft will fulfill these requirements. FY 1988 RDT&E funds will be used for Operational Test and Evaluation (OT&E) of the aircraft as modified to meet the air defense mission.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: Not Applicable

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

Aircraft modification/PE #: 27139F:

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total
Funds	182,592	441,907	0	0	92,200	716,699
Quantities	10	20	60	60	120	270

5. (U) RELATED ACTIVITIES: Not Applicable

6. (U) WORK PERFORMED BY: To be determined. Air Force Operational Test Evaluation Center, Kirtland AFB, NM, will be the in-house organization responsible for administering the Operational Test & Evaluation effort. Air Force Systems Command's Armament Division, Eglin AFB, FL, will be responsible for all weapons certification.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3632, Air Defense Competition

A. (U) Project Description: This PE provides for procurement of modification kits for the F-16A which was

selected to be the follow on replacement Air Defense (AD) Aircraft and funds the Operational Test and Evaluation (OT&E) efforts to ensure mission capability of the weapons system. This is required to address the need created by the growing obsolescence in the Air Defense forces resulting from the aging F-4 C/D and F-106 aircraft.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Received proposal responses from Northrop and General Dynamics. The Air Force completed the technical evaluation and the cost evaluation in Oct 1986. Source selection was announced on 31 Oct. The Source Selection Authority was the Secretary of the Air Force.

(2) (U) FY 1987 Program: Begins procurement of kits to modify the F-16A for Air Defense.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The RDT&E request is required to accomplish Developmental Test and Evaluation (DT&E) and OT&E to verify ability of aircraft to perform to specification. Additionally, complete IOT&E testing evaluate capability of the selected aircraft to accomplish the Air Defense mission.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Testing continues to determine the effectiveness of the F-16A, with modifications, to identify and destroy cruise missiles.

(5) (U) Program to Completion: OT&E efforts including weapons qualification/certification will be completed in the fourth quarter 1989. Procurement will begin in FY 1987 and continue through FY 1991.

C. (U) Major Milestones:

Milestones	Dates
(1) (U) First Delivery	1st Quarter FY 1989
(2) (U) Complete OT&E/Weapon Certification	4th Quarter FY 1989
(3) (U) Initial Operational Capability (IOC) 1st Operational Squadron	4th Quarter FY 1989

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 27162F
DOD Mission Area: 224 - Defense Suppression

Title: Tactical Air-to-Ground Missiles
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		1,795	967	2,348	0	0	36,121
2330	High Speed Radiation Missile (HARM)	1,795	967	2,348	0	0	36,121

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The increased sophistication, concentration, and lethality of enemy ground-based, radar guided, missile and antiaircraft artillery systems threaten the ability of tactical aviation to accomplish its mission and survive. Antiradiation missiles provide a destructive counter to this threat. The HARM has been developed by the Navy and Air Force to provide a significantly upgraded capability against the threat. The current HARM performance characteristics were defined during the Defense System Acquisition Review Committee (DSARC IIA) in February 1978. The threat has evolved during the ensuing period. The F-4G Wild Weasel represents the only dedicated destructive defense suppression weapon system in the Air Force inventory and the HARM is its primary weapon.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	1,943	2,377	2,398	N/A	0	37,729
Missile Procurement	414,807	493,382	402,654	N/A	242,011	2,182,554

EXPLANATION: (U) Gramm-Rudman-Hollings cuts and FY 1987 prior year inflation savings reduced FY 1986 RDT&E funds by $133,000. The difference in RDT&E total estimated cost includes FY 1986 changes. Gramm-Rudman-Hollings cuts reduced FY 1986 procurement funds by $36 million which reduced the quantity of missiles to 1384. Congressional action reduced the FY 1987 request by $130 million and denied multiyear procurement authority. The impact in FY 1987 is the loss of 746 missiles.

Program Element: 27162F
DOD Mission Area: 224 - Defense Suppression

Title: Tactical Air-to-Ground Missiles
Budget Activity: 4 - Tactical Programs

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
High Speed Anti-Radiation Missile (HARM)						
Procurement (Missile)*	390,370	363,688	422,945	214,914	61,508	2,082,400
Quantities	1384	1384	1748	893	276	7114

*Excludes initial spares

5. (U) RELATED ACTIVITIES: The HARM has been designated as the primary Anti-Radiation Missile for the F-4G Wild Weasel. A Memorandum of Agreement of July 1975 between the Air Force and Navy Assistant Secretaries for Research and Development names the Navy as the Executive Service and the Air Force as the Participating Service in the joint service HARM development program. The F-4G/APR-38 Radar Homing and Warning Receiver is optimized in Program Element 27136F, F-4G Wild Weasel Squadrons, to fully use HARM's capabilities. The integration of HARM on to the F-16C/D Multirole Tactical Fighter is in PE 27133F. Navy resources for Lower Cost Seeker (LCS) development are in Program Element 63301N, Electrical Radiation Source Elimination, and Air Force resources are covered in PE 63320F, Lower Cost Seeker.

6. (U) WORK PERFORMED BY: The HARM Development Program is managed by the Navy HARM Program Office, at Naval Air Systems Command, Arlington, VA, with an Air Force Deputy Program Manager and staff. Management of Air Force unique requirements is provided by the Armament Division, Eglin AFB, FL. Principal contractors are: Texas Instruments, Lewisville, TX; builds the seeker and control unit; Thiokol, Brigham City, UT: manufactures the rocket motor; and Motorola, Scottsdale, AZ: builds the fuze. Government organizations such as the Aeronautical Systems Division, Wright-Patterson, AFB, OH; Naval Weapons Center, China Lake, CA; and the Air Force Flight Test Center, Edwards AFB, CA perform aircraft interface, systems engineering, and flight test activities. Air Force independent testing is conducted by dedicated personnel from the Air Force Operational Test and Evaluation Center (AFOTEC), Kirtland AFB, NM; and by operational Tactical Air Command aircrews detailed to an AFOTEC test detachment.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2330, HARM.

A. Project Description: The requirement for an advanced HARM was identified by the Tactical Air Forces (TAF) in March 1975. Missile design goals are: moderate missile size and weight, short time to target from level launch at 10,000 feet, 0.8 Mach to target at 10 nautical miles); high accuracy median Closest Point of Approach); high sensitivity wideband frequency coverage in a single seeker ; long standoff range (up to nautical miles); and the ability to The Air Force identified the AGM-88 HARM as the solution for the near term

PE : 27162F

portion of this requirement. The HARM, integrated with the F-4 Wild Weasel, gives the TAF a dedicated and highly capable antiradiation weapon system. The F-4G/HARM will be the lethal defense suppression weapon system in the field for a considerable time into the future. This project includes two new product update programs to improve the HARM performance against the newer threats. HARM is most capable against the

The improvement programs will improve HARM capability via software and hardware updates. The Air Force, as participating service, will share with the Navy in funding these updates to HARM. The first update, commonly called Block III, is only a software change and will be incorporated in FY 1986 production missiles. The subsequent update, called Block IV, includes software and hardware modifications and will be available for incorporation in late FY 1989 or FY 1990 production missiles.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: A correction of deficiencies program was initiated to optimize the effectiveness of HARM against the current threat. This program will improve the missile computer processing capability and software to increase effectiveness in the expected dense signal environment, as well as to handle the newer, more complex signals by expanding and supplementing the missile's instantaneous bandwidth. Initial software design/development and simulator testing was completed followed by the start of software coding. The Air Force procured 1384 missiles in FY 1986.

(2) (U) FY 1987 Program: The Air Force will continue the software development program. Software coding and laboratory testing will be completed. Initial flight testing of the software improvements will be started. Initial design and development of the Block IV update will begin. The Air Force plans to procure 1384 missiles in FY 1987.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: In FY 88 the Air Force will continue efforts to keep HARM abreast of threat. DT&E to verify software performance will be completed. Software updates will be incorporated into production and retrofit into the existing missiles. Erasable Electronically Programmable Read Only Memory will replace the existing programmable memories to reduce upgrade cost and improve HARM availability to the user. Block IV update development and test will continue. The Research Development Test and Evaluation (RDT&E) cost estimate is Type IV based on program office engineering cost projections and contractor quotes. FY 1988 is the last planned year of RDT&E activity.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Not Applicable.

(5) (U) Program to Completion: Not Applicable.

C. (U) Major Milestones:

		Milestones	Dates
(1)	(U)	Defense System Acquisition Review Council (DSARC I)	October 1972
(2)	(U)	DSARC II	January 1977
(3)	(U)	DSARC II A	February 1978
(4)	(U)	DSARC II B	November 1980
(5)	(U)	DSARC III	March 1983
(6)	(U)	Air Force first delivery	December 1983
(7)	(U)	Air Force Initial Operational Capability	September 1984

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

Budget Activity: <u>4. Tactical Programs</u>
Program Element: <u>27162F, Tactical Air-to-Ground Missiles (AGM-88)</u>

<u>Test and Evaluation Data</u>

1. (U) <u>Development Test and Evaluation (DT&E)</u>: The AGM-88 High Speed Antiradiation Missile (HARM) is a joint Navy/Air Force project with the Navy as Executive Service. The Navy conducted Engineering Development under Program Element 64360N. Naval Weapons Center, China Lake was the lead organization. Texas Instruments was chosen as the Weapon System Integration Contractor. The Air Force Development Test and Evaluation addressed the integration of the HARM with the F-4G Wild Weasel, which contains the APR-38 avionics suite. Since 1977, modifications to the F-4G to integrate the HARM have been developed, bench tested, and have flown in a series of captive flight missions. Computer software developed to integrate the HARM with the APR-38 has been bench/ground tested and evaluated in captive flight tests and HARM firings from the F-4G.

(U) Prototype missiles and pilot production missiles were procured during DT&E. Prototype and pilot production hardware contain extended HARM frequency coverage and improved maneuverability capabilities which were developed during the extended phase of advanced development. Test results are shown in Navy Program Element 64360N Descriptive Summary.

Prototype Missiles - These missiles were tested to evaluate performance of the contractor prototype design against a variety of target signatures in five operational scenarios. The prototype hardware was subjected to ground tests, captive flight tests and firing tests. Objectives included acquisition and tracking of characteristic target signatures in various operational scenarios, compatibility with the full electromagnetic environment, and verification of hazard free performance to aircraft and handling personnel. An indication of operational effectiveness and suitability was obtained. The modified F-4G/APR-38 avionics capability to control and monitor the High Speed Antiradiation Missile (HARM) was demonstrated. Eighteen development test firings were completed, resulting in thirteen successes, three partial successes and two failures. The average miss distance was (as compared to the required circular error probable). Although these were development tests, they were fired by operational test pilots from both services. A Department of the Navy Systems Acquisition Review Council II B held in Nov 1980 evaluated test results of prototype missile firings, and approved proceeding to pilot production in 1981.

(U) Pilot Production Missiles - Forty-five pilot production missiles were allocated for both completion of Development Test in the Navy Technical Evaluation, and for the joint Air Force Initial Operational Test and Evaluation, (IOT&E) and Navy Operational Evaluation. Five of the forty-five pilot production missiles were fired by the Navy to complete Navy Technical Evaluation. The joint operational testing commenced in Nov 1981, and the balance of the forty pilot production missiles were allocated between the Navy and the Air Force. Twenty missiles were used for Navy Operational Evaluation, of which sixteen were fired. The Air Force used the remaining twenty missiles for IOT&E, firing sixteen of the twenty missiles. The joint test was completed in time for the Defense Systems Acquisition Review Council III in March 1983. The test program prior to Milestone III evaluated the pilot production missiles, avionics, peculiar ground support equipment and government furnished equipment against the full array of specification, operational effectiveness, and operational suitability requirements.

Testing following the production decision focused on HARM integration on the F/A-18, verification of the FY 82 software, and A-7E operational launch. Eight launches were conducted with three successes, six of these were from the F/A-18 and one each from an F-4G and A-7E. The F/A-18 launches pointed out a much more severe launch environment from the F/A-18 than experienced on the F-4G and A-7E, (3 of the 6 F/A-18 launches resulted in misses). HARM launches from Air Force F-4Gs have not experienced aircraft flow field problems. Two other HARMs missed [ ] targets.

More recent HARM launches of the FY 84 software update to alleviate the F/A-18 launch problem and improve performance against [ ] targets have been completely successful (6 successes for 6 launches including an F/A-18 supersonic launch and an F-4G launch against a [ ] target.

2. (U) Operational Test and Evaluation (OT&E): Follow-on Operational Test and Evaluation (FOT&E) of the High Speed Antiradiation Missile (HARM) built by Texas Instruments, Lewisville, Texas, will be conducted from 1 April 1984 to 30 March 1987. The purpose of FOT&E is to evaluate the effectiveness and reliability of production missiles, verify corrections to deficiencies identified during IOT&E, evaluate ground support equipment, and verify technical orders.

(U) An Air Force preliminary evaluation (AFPE) was conducted (Jan 79 - Oct 80) in combination with Development Test and Evaluation (DT&E), using prototype missiles to obtain early data on operational effectiveness and suitability. During DT&E, eight missiles were fired from the F-4G Wild Weasel by operational aircrews from the Tactical Air Command (TAC). Navy and Air Force maintenance personnel monitored missile buildup, test, repair, and maintenance actions by the contractor. The test was successfully completed with recommendation of proceeding with IOT&E provided deficiencies were corrected.

(U) The Air Force HARM Initial Operational Test and Evaluation (IOT&E) was conducted from November 1981 to October 1982 in two phases. Phase I, which ended May 1982, consisted of six missile firings from the F-4G aircraft. Phase II, which began in June 1982, consisted of 12 missile firings to validate a software enhancement update to the missile (equations of motion). In addition, an extensive captive-carry flight program was conducted to evaluate missile effectiveness and reliability. The HARM weapon system is projected to perform satisfactorily. It met most operational requirements within the areas of operational effectiveness and suitability. The most significant of the deficiencies identified during testing were corrected in the FY 84 software update which has been incorporated into HARM production. Remaining deficiencies are being addressed in the ongoing Block III software development.

(U) The Air Force HARM FOT&E Phase I is being conducted in a two-phased approach. Both phases will utilize production missile and ground support equipment. All missiles will be integrated with the F-4G Wild Weasel. FOT&E Phase IA was conducted from 1 April 1984 to 2 November 1984 and consisted of one missile firing. Additionally, an extensive captive-carry flight program was conducted to evaluate production missile effectiveness and

reliability. Phase IB will be conducted from 1 January 1986 to 30 March 1987 and will consist of four missile firings. Due to range safety limitations the one live warhead firing was deleted. This phase will evaluate FY 84 production software, which corrects the majority of deficiencies identified during IOT&E, and will be integrated with the first phase of the AN/APR-38 performance upgrade program (PUP) to the F-4G. Air Force testing will be conducted on test ranges at Nellis AFB, Nevada and Naval Weapons Center, China Lake, California. USAF operational aircrews and maintenance personnel will be utilized throughout FOT&E.

(U) System performance and reliability criteria are outlined in Decision Coordination Paper 93B.

(U) Operational Test and Evaluation (OT&E) reports published:

(1) (U) High Speed Antiradiation Missile (HARM) Air Force Preliminary Evaluation (AFPE), January 1981 (S).
(2) (U) High Speed Antiradiation Missile (HARM) IOT&E Final Report, April 1983 (S).
(3) (U) High Speed Antiradiation Missile (HARM) IOT&E Final Report Annex, May 1983 (S).

(U) HARM Test and Evaluation Master Plan (TEMP), dated 29 Mar 83. Updated TEMP is in OSD for approval.

3. System Characteristics:

CHARACTERISTICS	MILESTONE IIB THRESHOLD	MILESTONE III THRESHOLD	MILESTONE III GOAL 1/	DEMONSTRATED
Range:				
(Level Launch) Nautical Miles				
5,000 Ft Altitude				
15,000 Ft Altitude				
30,000 Ft Altitude				
Accuracy:				
Median of the Closest Point of Approach (in Feet)				

Budget Activity: 4. Tactical Programs
Program Element: 27162F. Tactical Air-to-Ground Missiles (AGM-88)

CHARACTERISTICS	MILESTONE IIB THRESHOLD	MILESTONE III THRESHOLD	MILESTONE III GOAL 1/	DEMONSTRATED
Frequency Coverage:				
(Gigahertz) Pulse Continuous Wave				
Technical:				
Length (Feet)	15	15	13	13.7
Diameter (Inches)	11	11	10	10.5
Weight (Pounds)	807	807	780	780
Time to Target (Level launch at 10K ft, .8 Mach to target at 10 NM)(Seconds)				
Mean Flying Hours Before Failure (Hours) (Captive Carry over 1850 test hours, 1.8 flying hrs per sortie, including 1.0 hour full electrical power)	Not Applicable	125	181	55.5 4/
Reliability, Missile Captive Carry	Not Applicable	.75	.82	.99 4/ 5/
Reliability, Missile Free Flight	Not Applicable	.85	.95	.84 4/ 6/

Budget Activity: 4. Tactical Programs
Program Element: 27162F, Tactical Air-to-Ground Missiles (AGM-88)

1/ (U) DCP-93B Goals, 1 December 1982

2/ (U) Includes Air Force and Navy Initial Operational and Test Evaluation (IOT&E) firings

3/ (U) Demonstration based on results of IOT&E

4/ (U) Results shown are based on the AFOTEC IOT&E report only and reflect Air Force results from a limited sample size of 943.7 missile flight hours.

5/ (U) Probability that High Speed Antiradiation Missile (HARM) will be up and ready for launch after 20 captive carry flights of 1.8 hours duration per mission with full electrical power applied for one hour per mission. Relates to a Mean Flying Hours Before Failure threshold of 125 hours and goal of 181 hours.

6/ Given an up HARM system at launch, probability of successful launch, target guidance (including operation, if required) and proper fuze and warhead function within the specified Median of the Closest Point of Approach. Target is defined as any emitter having parametric characteristics similar (within missile radar frequency and search area discrimination limits) to one of the handed off by the avionics.

Budget Activity: 4. Tactical Programs
Program Element: 27162F. Tactical Air-to-Ground Missiles (AGM-88)

4. Current Test and Evaluation (T&E):

T&E Activity (Past 12 Months)

Event	Planned Activity	Actual Date	Remarks
FY 84 Software DT&E/FOT&E IB	Jan 86-Apr 86	Feb 86-Sep 86	First launch: Missile missed the target due to an out-of-missile-tolerance target altitude input from the F-4G. The APR-38 software has been corrected and incorporated. Missle baro-altimeter performance is under review. Second launch: Successful off azimuth shot from altitude and to within of the target.

T&E Activity (Next 12 Months)

Event	Planned Date	Remarks
FOT&E Phase 1B	Oct 86-Mar 87	Firings were rescheduled for test support problems not related to missile performance. In progress.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 27168F
DOD Mission Area: 371 - Self-Protection

Title: F-111 Self-Protection Systems
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT			0	58,007	52,869	Continuing	N/A
3322	Self-Protection Jammer for F/FB/EF-111	*	0	58,007	52,869	Continuing	N/A

* Funding contained in special access programs.

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This element funds the development, test, production and installation of updated self-protection jammer and radar warning systems for F/FB/EF-111 aircraft. Modification of approximately 382 aircraft is planned. These systems are

The jammer system provides

The F/FB/EF-111 Self-Protection ECM Update program will be divided into two phases. The first phase, limited development consists of those efforts required to complete system design and development, to integrate the selected system into F/FB/EF-111 aircraft, and to complete support equipment development. The second phase, production, consists of five FY lot options for the purchase of Group B systems, Group A kits, and support equipment. The radar warning receiver (RWR) (ALR-62I) is in the pre-production stage. These programs have been on-going since FY 1983 under special access program elements. All funds for these programs have been transferred out of the special access program elements for FY 1987 and now appear in the new element, 27168F. FY 1986 funds for these programs will remain in the special access program elements since they cannot be moved to the new program element without a Congressional reprogramming. Budget is based on contractor estimates.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: Not Applicable.

Program Element: 27168F
DOD Mission Area: 371 - Self-Protection

Title: F-111 - Self-Protection Systems
Budget Activity: 4 - Tactical Programs

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Aircraft Procurement						
Funds	*	0	0	45,100	945,900	991,000
Quantities					382	382

*FY 1986 and prior funding contained in special access programs.

5. (U) RELATED ACTIVITIES: Not Applicable.

6. (U) WORK PERFORMED BY: In April 1985 OSD directed that the jammer system be competed. Selection of a winner is anticipated in 2nd quarter FY 1987. The Radar Warning Receiver (RWR) System is being developed by Dalmo Victor of Belmont, CA. The jammer program is managed by the Aeronautical Systems Division, Wright-Patterson AFB, Ohio, and the RWR is managed by the Warner Robins Air Logistics Center, Robins AFB, Georgia.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3322, Self-Protection Jammer for F/FB/EF-111

A. Project Description: This system is

as well as those of improved older systems. FY 1986 RDT&E special access funds are to allow completion of development, testing and planning, essential to support the jammer competition. FY 1988 and outyear RDT&E funds are for completion of essential and nonrecurring engineering and test activities by the winning contractor.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: While the ALQ-189 self-protection jammer effort continued, the program office, obtained approval for the business/acquisition strategy, released a RFP to Industry and began source selection procedures.

(2) (U) FY 1987 Program: FY 1986 RDT&E special access funds will be used for initial funding of the winning jammer contractor. Planned activity includes: Contract award, aircraft jammer integration, Group A development, limited Group B development, support equipment development and integration, initial qualification, performance and reliability testing. Actual activities and schedule are a function of which contractor wins the competition.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Activities include completion of those activities started in FY 1987 plus test aircraft modification and fabrication of Group A. FY 1988 activities depend on contractor selection. Specific activities and schedules are dependent on which contractor wins the competition. Planned activities include continued hardware (Group B) development, FB-111 integration and Group A development, I and O level support equipment development and test data reduction. Existing cost estimates are based on preliminary contractor estimates in June 1985, category V.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Activities include continuing system development, continuing FB-111 integration and beginning EF-111 Group A development/system integration, Development Testing and Evaluation, continued I and O level support equipment (SE) development and starting depot SE efforts, test data reduction, technical manual development and initial training on the system.

(5) (U) Program to Completion: Complete RDT&E activities started in FY 1989. Under existing plans this would occur in FY 1990: Exercise production options for fabrication and delivery of Group A and B kits for installation during Programmed Depot Maintenance through FY 1996.

C. (U) Major Milestones:

	Milestones	Dates
(1) (U)	Release of Request for Proposals	March 1986
(2) (U)	Winning Jammer Contract Award	2d Quarter 1987
(3) (U)	Start System Development	2d Quarter 1987
(4) (U)	Start DT&E	3d Quarter FY 1989
(5) (U)	Advanced Production Buy	3d Quarter FY 1989
(6) (U)	Complete DT&E	4th Quarter FY 1989
(7) (U)	Low Rate Production Contract	2d Quarter FY 1990
(8) (U)	Start IOT&E	3d Quarter FY 1990
(9) (U)	Complete IOT&E	4th Quarter FY 1990
(10) (U)	First Install	4th Quarter FY 1991
(11) (U)	Initial Delivery of Production Jammer	4th Quarter FY 1991*

* Actual date is a function of which contractor wins the jammer competition.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 27215F
DOD Mission Area: 327 - TIARA for Tactical Air Warfare

Title: TR-1 Squadrons
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		0	20,454	74,923	102,307	Continuing	N/A
3314	TR-1	0	20,454	74,923	102,307	Continuing	N/A

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The TR-1 Tactical Reconnaissance System provides the United States and allied forces in the NATO Central Region with near-real-time battlefield surveillance using [ ] the Advanced Synthetic Aperture Radar System II (ASARS II) imaging radar carried aboard the TR-1 aircraft. This sensor information is exploited in the TR-1 ground station located at the [ ] This program replaces the unprotected above ground prototype TR-1 ground station [ ] with a fully protected below ground, bunkered ground station. This ground station will be as survivable as the command structure it will support. The TR-1 program develops non-sensor related segments of the ground station and integrates the sensor exploitation segments into the ground station. These non-sensor segments of the ground station provide mission planning and control, communications, and maintenance support. They also provide the means to coordinate the activities of the various sensor exploitation segments to form an integral battlefield surveillance system.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	0	23,509	33,897	N/A	Continuing	N/A
Other Procurement	10,103	0	43,724	N/A	105,049	198,876

EXPLANATION: (U) The TR-1 Ground Station program has been restructured from a largely production program to one involving larger amounts of development to incorporate lessons learned from the prototype ground station currently operational in Germany. Production funds were converted to RDT&E. In addition a second, fully capable ground station was added replacing the refurbished prototype as the second European ground station. The program now fully meets the theater commander's requirement. The FY 1987 change to RDT&E is due to congressional action.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
Other Procurement						
Funds	13,679	61	6,450	8,085	75,653	103,928
Quantities*						

Program Element: 27215F
DOD Mission Area: 327 - TIARA for Tactical Air Warfare

Title: TR-1 Squadrons
Budget Activity: 4 - Tactical Programs

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Military Construction:						
Funds	18,375	7,630	0	8,500	22,213	57,718

* (U) FY 1988 funds procure support equipment for first TR-1 Ground Station radar processor procured in FY 1985, plus changes to government funded equipment to permit installation in a fixed instead of transportable facility.

5. (U) RELATED ACTIVITIES: The Side Looking Airborne Radar (SLAR) Program Element 64756F, Project 2037, SLAR Sensors and Project 2451, SLAR Exploitation, funds development of radars and exploitation equipment used in the TR-1 aircraft and ground station.

6. (U) WORK PERFORMED BY: This program is managed by Aeronautical Systems Division, Wright-Patterson AFB, OH. The effort is on contract through Preliminary Design Review, scheduled for April-May 1987, with Ford Aerospace, Palo Alto, CA.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3314, TR-1

A. Project Description: This project develops portions of the TR-1 ground station that are sensor independent. These include the mission control capability, communications element and maintenance support facility. These functions provide crucial mission planning, sensor tasking, sensor control, communications to tactical commanders, and maintenance support to the Advanced Synthetic Aperture Radar System II radar processing and exploitation segments of the TR-1 ground station. This project also funds the procurement of the exploitation segment developed in Program Element 64756F.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Not Applicable.

(2) (U) FY 1987 Program: This effort leads to system preliminary design reviews in April-May 1987. The effort includes mission planning, control, tasking, communications and logistics support development, facility design and subsystem and system level test planning. System architecture will be finalized and preliminary hardware and software design will be completed. Changes required to government furnished equipment in order to install it in a

fixed facility instead of a transportable shelter will be finalized. Initial work station hardware procurement will begin. Operational testing of the deployed functional prototype ground station will be completed prior to the design review.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: System software and hardware design will continue, resulting in a Critical Design Review in mid-year. Major hardware procurement and assembly will begin. Segment level testing of software will begin. Logistics support development will continue, aimed at providing a maximum capability for integral Air Force maintenance support for TR-1 Ground Stations in the field. Changes resulting from the operational test of the prototype ground station, currently operational in Germany, will be introduced in the TR-1 Ground Station design. The cost estimate is based on experience with the Tactical Reconnaissance Exploitation Demonstration System (TREDS) functional prototype. The estimate is also based on parametric analysis of limited cost, design and performance descriptions, Category III, Budgetary. The estimate assumes the program continues as a sole source development.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: System level integration will begin at the contractor's plant, bringing together the Advanced Synthetic Aperture Radar System (ASARS) II exploitation segments, mission control segment, and communications and support elements.

(5) Program to Completion: This is a continuing program. In FY 1990 contractor integration will be completed. Operator training will begin. In addition, design and hardware procurement for the second TR-1 ground station will begin. In the first quarter of FY 1990 the hardened facility will be ready for occupancy. The first TR-1 ground station will be shipped to Germany, installed, tested
In FY 1991 and FY 1992 hardware procurement and design effort for the second ground station will continue. Changes resulting from testing the first ground station will be made to both ground stations. In 1993 system integration of the second ground station will begin at the contractor's facility, with shipment to Germany occurring in the fourth quarter.

C. (U) Major Milestones:

		Milestones		Dates
(1)	(U)	First TR-1 Contract		November 1979
(2)	(U)	TREDS Contract Award		July 1981
(3)	(U)	First TR-1 Delivered		September 1981
(4)	(U)	ASARS II Operational Evaluation		November 1982
(5)	(U)	ASARS II Production Award		September 1983
(6)	(U)	TREDS Delivery to Europe		August 1985
(7)	(U)	TREDS Operational Test Complete	*(October 1986)	December 1986
(8)	(U)	TR-1 Ground Station (TRIGS) Element Level Testing		August 1988
(9)	(U)	TRIGS Contractor System Integration		September 1989

Program Element: 27215F
DOD Mission Area: 327 - TIARA for Tactical Air Warfare

Title: TR-1 Squadrons
Budget Activity: 4 - Tactical Programs

	Milestones	Dates
(10)	TR-1 Ground Station (TRIGS) Initial Operational Capability	[ ]
(11) (U)	TRIGS II Integration	September 1993
(12)	TRIGS/TR-1 Full Operational Capability [	]

*Date presented in FY 1987 Descriptive Summary.

(U) Explanation of Milestone Changes

(7) (U) Tactical Reconnaissance Exploitation Demonstration System Operational Test delayed two months because of similar delay in starting computer security upgrades.

(12) (U) TRIGS/TR-1 Full Operational Capability slipped two years due to the decision to provide a second, full capability ground station instead of a hardened prototype. This change fully meets the theater requirement for TR-1 ground stations.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

Budget Activity: 4, Tactical Programs
Program Element: 27215F, TR-1 Squadron

Test and Evaluation Data

1. (U) Development Test and Evaluation (DT&E): The TR-1 aircraft is a follow-on to the U-2R, whose required operational characteristics have been verified by over sixteen years of day to day operations. As such, no additional Development Test and Evaluation (DT&E) or Operational Test and Evaluation (OT&E) of the aircraft is accomplished under this program element. However, the TR-1 Tactical Reconnaissance System (TRS) development program does sponsor sensor and ground station test programs as summarized below.

DT&E of the

processing and reporting is complete. This system completed contractor integration and testing in October 1979, and Initial Operational Test and Evaluation in March 1980. All test program action items are complete, and all system deficiencies have been either addressed via changes to ongoing contracts, or programmed for outyear implementation pending approval of funds.

(U) The Advanced Synthetic Aperture Radar System (ASARS II) development effort consists of two major projects managed by the Aeronautical Systems Division. One of these projects is with the Hughes Aircraft Corporation for development of an airborne sensor and a radar ground processor. The second project involves design of a ground facility to exploit ASARS imagery. Multiple program requirements are being addressed in these projects to meet the need for strategic/national and tactical SLAR collection, processing, timely exploitation and reporting during peace, crisis and war. Specific system requirements for the U-2R, and tests conducted on the U-2R, apply directly to the follow-on procurement of the Advanced Synthetic Aperture Radar System airborne and ground elements for the TR-1.

2. Operational Test and Evaluation (OT&E): The Air Force Operational Test and Evaluation Center is managing the TR-1 Tactical Reconnaissance System (TRS) OT&E program. The TRS OT&E program consolidates test directives from the Side-Looking Airborne Radar (SLAR) PE 64756F and where those programs provide capability as part of the TR-1 TRS.

Phase I involves the maximum utilization of previous test data to save resources. TRS is combining already operational equipments with new capabilities in development. Phase I consolidates test data from the conducted by Electronic Security Command (ESC) and AFOTEC and the Airborne Synthetic Aperture Radar System (ASARS) operational utility evaluation (OUE) conducted by AFOTEC. The notion is that, by using the previous test data as baselined capability, only enough data need be taken in future tests to verify that those systems still operate at least as well as baselined. The results of Phase I are as follows:

Budget Activity: 4, Tactical Programs
Program Element: 27215F, TR-1 Squadron

Electronic Security Command (ESC) conducted an initial operational test and evaluation (IOT&E) of the original (prototype)

ESC conducted a reassessment of the prototype

An was conducted by Air Force Operational Test and Evaluation Center (AFOTEC) on all from 1 October 1983 to 12 January 1984. The report concluded that

AFOTEC conducted an Advanced Synthetic Aperture Radar System (ASARS II) Operational Utility Evaluation (OUE) which was completed in November 1982 Supportability, reliability, and maintainability were rated satisfactory. Minor problems in support hardware, Line Replaceable Unit (LRU) reliability, and degree of maintenance difficulty were observed.

AFOTEC is currently conducting an IOT&E (Phase II) of the TRS prototype and will conduct an FOT&E (Phase III) of the production TRS system.

(U) The overseas TR-1 TRS IOT&E(2) is currently in progress and will be accomplished from 16 June 1986 to 19 December 1986. The three critical issues of the TRS to be evaluated are: (1) timely response to tasking, (2) utility of system products to the tactical commanders, and (3) adequacy of reliability and maintainability characteristics. The first two critical issues address the operational effectiveness of the TRS, while the third addresses the suitability, (reliability, availability, and maintainability capability) of the system. The IOT&E is taking place in the European theater where the operational environment is favorable for all aspects of the test. Determination of timeliness and utility of system products to theater commanders during wartime will be accomplished

through in-theater wartime simulation. The primary operating units supporting the OT&E are the 17th Reconnaissance Wing (RW) at RAF Alconbury, United Kingdom (aircraft Main Operating Base (MOB)) and the 6911th Electronic Security Squadron (ESS) and 7451st Tactical Intelligence Squadron (TIS), Hahn AB, Germany (Metro Tango ground site). Emphasis of the prototype testing will be to evaluate system capability to meet Initial Operational Capability (IOC) parameters and to provide maximum benefit to the production design and system effectiveness.

(U) The reports published to date are:

(1) [ ] IOT&E Test Report, Electronic Security Command (ESC), March 1980 (S/SCI).

(2) (U) Follow-up RTASS IOT&E Report, ESC, September 1981 (S/SCI).

(3) (U) Advanced Synthetic Aperture Radar System (ASARS II) Operational Utility Evaluation Final Report, Air Force Operational Test and Evaluation Center (AFOTEC), April 1983 (S/SENIOR YEAR Program Material).

(4) (U) RTASS FOT&E Final Report, AFOTEC, March 1984 (S/SI).

3. (U) Systems Characteristics:

(U) ADVANCED SYNTHETIC APERTURE RADAR SYSTEM (ASARS):

(U) Characteristic	Objective/Threshold	Demonstrated
Search Mode		
Range		
Swath Width		
Squint Angle		
Resolution		
Spotlight Mode		
Range		
Spot Size		
Squint Angle		
Resolution		

850 022

850

Budget Activity: 4, Tactical Programs
Program Element: 27215F, TR-1 Squadron

(U) TR-1 AIRCRAFT: All required operational characteristics verified by over 15 years of U-2R operation. Procurement organization will perform routine acceptance flight tests on each aircraft prior to delivery.

4. (U) Current Test and Evaluation (T&E):

T&E Activity (Past 12 Months)

	Event	Planned Date	Actual Date	Remarks
(U)	Dedicated Overseas IOT&E Start	15 June 1986	16 June 1986	IOT&E in progress

T&E Activity (Next 12 Months)

	Event	Planned Date	Remarks
(U)	Dedicated Overseas IOT&E	16 June-19 December 1986	Progressing as planned

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: #27217F
DOD Mission Area: #327 - TIARA for Tactical Air Warfare

Title: Follow-On Tactical Reconnaissance System
Budget Activity: #4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	0	17,672	55,561	54,084	Continuing	N/A
3201	Tactical Air Reconnaissanco System	0*	9,126	45,769	43,842	Continuing	N/A
3364	Joint Services Imagery Processing System	0**	8,546	9,792	10,242	Continuing	N/A

* Program funded under PE 63239F, Advanced Tactical Air Reconnaissance System, in FY 85 and FY 86.
** Program funded under PE 27435F, Tactical Reconnaissance Imagery and Exploitation System, in FY 87.

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Follow-on Tactical Reconnaissance System (FOTR) and the associated Tactical Air Reconnaissance System (TARS) project is an essential element of the Advanced Tactical Air Reconnaissance System (ATARS) umbrella concept. The Program Element focuses on full-scale development of a common family of Electro-Optical (EO) sensor suites (sensors, data-link sets, recorders, and reconnaissance management system) for upgrade of both USAF and Department of Navy (DON) manned and unmanned reconnaissance systems (TARS). Specifically, the Air Force will integrate EO sensor suites into the RF-4C, a Joint USN/USAF medium-range unmanned system and a follow-on tactical reconnaissance pod for carriage on a fighter aircraft. The DON plans for EO sensor suite integration into the medium-range unmanned system, upgrade of the USMC F/A-18D reconnaissance aircraft and transition of the USN F-14D Tactical Air Reconnaissance Podded System (TARPS) from film to EO capability. Concurrent development of a ground exploitation system will be conducted using modular technology derived from the USAF/USMC/USA Joint Services Imagery Processing System (JSIPS). JSIPS was formerly known as the Advanced Deployable Digital Imagey Support System (ADDISS). The ground station will have commonality to Air Force manned and unmanned systems. TARS is designed to meet the needs of the tactical commander for detection, location and classification of tactical targets with sufficient location accuracy and detail to permit the timely delivery of appropriate air or ground launched weapons. The Tactical Air Forces Statement of Need 320-79 and corresponding Justification for Major System New Start, as approved by the office of the Secretary of Defense in August 1982, identified the requirement for near-real-time intelligence information. These requirements will be met by a mix of tactical reconnaissance platforms including standoff and penetrating manned and unmanned vehicles. Funding for FOTRS was included in PE 63239F, ATARS, in FY 1985 and FY 1986. Additional funding in FY 1985 was received from PE 64710F, Reconnaissance Equipment.

Program Element: #27217F Title: Follow-On Tactical Reconnaissance System
DOD Mission Area: #327 - TIARA for Tactical Air Warfare Budget Activity: #4 - Tactical Programs

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
RDT&E	0	30,583	19,935	N/A	Continuing	N/A

(U) Explanation of Changes: The FY 1987 reduction resulted from congressional action. The FY 1988 increase of $35.6256 million is the result of revised priced estimates based on Headquarters AFSC analysis.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable

5. (U) RELATED ACTIVITIES: Electro-Optical (EO) sensor suites developed in the FOTRS program and TARS project will be used to upgrade both Department of Navy and Air Force manned and unmanned vehicles. The Joint USN/USAF medium-range unmanned activities will be accomplished under PE 63239F (Air Force Unmanned Air Reconnaissance System - UARS), PE 64511N, W1870 (Navy Medium-Range Unmanned Vehicle), PE 63635M (Marine Medium-Range Unmanned Vehicle - 1987) and PE 64657M (Marine Medium-Range Unmanned Vehicle - 1988 and forward). An AF/USN Memorandum of Agreement (MOA), March 1985, designated the Air Force as lead service for sensor development and the USN as lead service for unmanned platform development. Navy manned activities will be accomplished under PE 63261N. Initial design/development efforts for the Joint Services Imagery Processing System (JSIPS) were funded by PE 27435F, Tactical Reconnaissance Imagery and Exploitation System.

6. (U) WORK PERFORMED BY: Contractors for EO sensor development have not been identified. The TARS Request for Proposal is scheduled for release in Jan 1987 with contract award anticipated in the Summer of 1987. During the Concept Validation Phase, General Dynamics, Fort Worth Texas, was the prime contractor for demonstrating the capability of an EO sensor suite and completing the reconnaissance simulation testing. The Aeronautical System Division, Wright-Patterson AFB, Ohio, has overall in-house management responsibility for system development and study efforts for TARS (Project 3201). Electronic Systems Division, Hanscom AFB, Massachusetts, has responsibility for in-house management responsibility for ground processing and exploitation equipment (project 3364). Contractors for the JSIPS design phase include teams of: Lockheed, Hughes, and PRC; General Dynamics, TRW, Sperry and Geodynamics; and E Systems, Goodyear, GE, and RCA. A single contractor team will be selected for JSIPS full-scale development.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable

8. (U) PROJECTS OVER $10 MILLION IN FY 1988 AND/OR 1989:

(U) Project: 3201, Tactical Air Reconnaissance System

Program Element: #27217F Title: Follow-On Tactical Reconnaissance System
DOD Mission Area: #327 - TIARA For Tactical Air Warfare Budget Activity: #4 - Tactical Programs

A. (U) Project Description: The Tactical Air Reconnaissance System (TARS) is a full-scale development project to meet the needs of tactical commanders for near-real-time detection, location and classification of tactical targets. These requirements will be met by a mix of tactical reconnaissance platforms including standoff and penetrating manned and unmanned vehicles. Program focuses on the development of common family of electro-optical (EO) sensor suites (sensors, data-link sets, recorders and reconnaissance management system) for upgrade of both USAF and Department of Navy manned and unmanned reconnaissance systems. Specifically, the Air Force will integrate EO sensor suites into the RF-4C, a Joint USN/USAF Medium-Range unmanned system and a follow-on reconnaissance pod to be used on a fighter aircraft. The program includes an EO sensor suite that will detect, classify and identify tactical targets both moving and stationary. The TARS system will provide a near-real-time data-link capability of reconnaissance imagery. The EO sensor suite will be common to Air Force manned and unmanned systems.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: The demonstration and validation phase focused on environmental testing and evaluation of EO backed cameras, recorders, data-link and reconnaissance management system carried in a reconnaissance pod. Program validated EO sensor effectiveness in a reconnaissance pod environment at low, medium and high altitudes. In addition, evaluation of exploitation requirements was accomplished using a modified Manual Airborne Radar Reconnaissance Exploitation System (MARRES) as an EO ground station testbed. In this manner, the total EO environment was validated in conjunction with flight testing. The simulation efforts were initiated to determine cockpit design and mechanization requirements for follow-on reconnaissance aircraft and to evaluate both dual-seat and single-seat capabilities. Funding in FY 1986 was executed under PE 63239F, Advanced Tactical Air Reconnaissance System (ATARS). During this period, a Single Best Estimate cost analysis was completed by HQ AFSC.

(2) (U) FY 1987 Program: Complete source selection activities and contract award for full-scale development (FSD) and design efforts of the EO sensor suite. The EO sensor suite will be integrated into the RF-4C, Joint USAF/USN Medium-range Unmanned Air Reconnaissance System (UARS) and follow-on reconnaissance pod for carriage on a fighter aircraft. Engineering design studies were initiated to determine RF-4C integration requirements and technical specifications. An Independent Cost Analysis (ICA) will be completed during FY 1987 which will update the preliminary cost estimates provided by HQ AFSC Single Best Estimate.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The program will continue with FSD design efforts begun in FY 1987. Following the initial contractor design responses, the Program Office will conduct a Preliminary Design Review (PDR) to compare contractor proposals with required technical specifications. Following PDR, the Program Office will complete Critical Design Review (CDR) to finalize the EO sensor suite design and specifications. The prime contractor will initiate fabrication and assembly efforts leading to nine engineering models delivered in FY 1990. In addition, the contractor will initiate development of support equipment to include common support equipment, peculiar support equipment and automated test equipment.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Category V cost estimates will be adjusted upon completion of an independent cost analysis. The contractor will continue fabrication and assembly efforts

started in FY 1988 leading to nine full-scale development (FSD) models to be delivered in FY 1990. Program will continue development of support equipment begun in FY 1988. Contractor will complete the form-fit function activity with airborne systems to verify configuration and sizing compatibility of electro-optical (EO) sensor suites. Contractor to complete trial installs with aircraft and unmanned system to insure design compatibility.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones:

Milestones		Dates
(1) (U) Program Initiation		August 1982
(2) (U) Concept Validation		October 1984
(3) (U) Full-Scale Development (EO suite)	*(Oct 1986)	June 1987
(4) (U) Production Decision	*(Jun 1990)	January 1990

*Date presented in FY 1987 Descriptive Summary.

(U) Explanation of Milestone Changes:

(3) (U) Full-Scale Development date changed due to delay in release of Request for Proposals.
(4) (U) Production decision accelerated due to change in overall ATARS schedule

9. (U) Project: 3364, Joint Services Imagery Processing System (JSIPS)

A. Project Description: JSIPS, formally known as the Advanced Deployable Digital Imagery Support System, provides a transportable tactical capability to receive, process, and exploit, in softcopy or hardcopy,

JSIPS will provide the Tactical Air Reconnaissance System (TARS) project with a ground station using the modular, exportable technology developed under JSIPS. Specifically, JSIPS (TARS ground station) will develop an imagery exploitation ground station to receive data from the TARS EO-equiped platforms. Designed to meet the tactical commander's need for near-real-time imagery for the detection, location and classification of tactical targets, JSIPS will replace the present photo processing and interpretation facilities associated with RF-4C aircraft. JSIPS will support the EO-modified RF-4C, the Unmanned Air Reconnaissance System, and the Follow-on Tactical Reconnaissance Pod.

As part of a multi-service program, JSIPS also supports the USMC All Source Imagery Processor and Army Imagery Processing and Dissemination Processing System requirements.

B. (U) Program Accomplishments and Future Efforts:

Program Element: #27217F   Title: Follow-On Tactical Reconnaissance System
DOD Mission Area: #327 - TIARA for Tactical Air Warfare   Budget Activity: #4 - Tactical Programs

(1) (U FY 1986 Accomplishments: Following a four-month source selection, three nine-month design competition contracts were let. Each of the three contractor teams completed the Joint Services Imagery Processing System (JSIPS) design through the System Design Review, conducted cost/schedule/technical trade-off studies and started technology demonstrations that demonstrated each team's ability to execute the program during full-scale development (FSD).

(2) (U) FY 1987 Program: The technical demonstrations by each contractor team will be completed and evaluated to insure the ability of each team to meet critical technical characteristic requirements of the JSIPS. Following completion of the design phase, a Request for Proposal (RFP) will be released, source selection completed and the three contractor teams will be down-selected to a single contractor team to complete FSD.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Full-scale development of the ground station will continue from efforts that began in FY 1987 and will be completed in late FY 198[illegible]. Software to support imagery exploitation and development of a standard imagery console will constitute the major portion of this year's development. Additional efforts will include integration of commercial off-the-shelf software and unique hardware items.

(4) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Integration and testing of the JSIPS Ground Station will begin in FY 1989. This will include a period of joint testing of the Air Force, Army and Marine Corps Engineering Development Models with service specific testing to follow. FSD of the baseline ground station will be established

(5) (U) Program to Completion: Continue full-scale development of production ground stations.

C. Major Milestones:

Milestones	Dates
(1) (U) Phase I Contract Complete	December 1986
(2) (U) FSD RFP Release	February 1987
(3) (U) Contract Award	June 1987
(4) ( ) Initial operational Capability (IOC) for JSIPS	
(5) ( ) Production Decision for JSIPS Ground Station	

10. (U) COOPERATIVE AGREEMENTS: The Air Force has entered into discussions with Germany and The Netherlands on the feasibility of a cooperative program. Both countries have expressed interest in upgrading their tactical reconnaissance capabilities and are considering the shift to EO imagery sensors. A cooperative project is being investigated based on the US developing the sensor suite and designing the F-16 sensor pod. The allies would accomplish pod fabrication, aircraft integration and conduct flight testing. AN USAF/USMC/USA Memorandum of Agreement has been reached that designates the USAF as the lead service for the development of JSIPS, establishes each Service's roles and responsibilities and defines fund sharing requirements.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 27247F — Title: Air Force TENCAP
DOD Mission Area: 322 - TIARA for Tactical Land Warfare — Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		230	102	313	324	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The primary objective of this program is to ensure national system support to our warfighters. In 1977 Congress directed each Service to establish a Tactical Exploitation of National Space Program Capabilities (TENCAP) office to improve military use of the national space systems. Air Force TENCAP initiatives include the development of procedures, tactics and interfaces (equipment and/or software) to guarantee national systems support to the tactical commander within the combat operations framework. This program also evaluates the above to determine the level and impact of tactical utility. Tactical Impact Statements are prepared for Congressional review documenting the utility of either new national programs and/or major modifications required to support tactical operations.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	244	105	320	N/A	Continuing	N/A

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. RELATED ACTIVITIES: As part of its functions, TENCAP strives to continuously expand the tactical use of existing national systems, also is the "honest broker" for the Air Staff when evaluating the use of [ ] conventional systems support to combat operations. TENCAP formally interfaces with numerous national space programs/agencies, the Major Commands (their components), the Air Staff, Office of the Secretary of Defense, Secretary of the Air Force, and the other Services in order to effectively influence the designs and concepts of the national systems. [ ] are also related activities in that they provide the national satellite capabilities addressed by the TENCAP initiatives.

6. (U) WORK PERFORMED BY: Air Force management of this effort is under the Air Force Deputy Chief of Staff for Plans and Operations, Headquarters USAF, Washington, DC.

Program Element: 27247
DOD Mission Area: 322 - TIARA for Tactical Land Warfare

Title: Air Force TENCAP
Budget Activity: 4 - Tactical Programs

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 27247F, Air Force TENCAP

A. Project Description: This program has as its main objective the development of procedures, tactics and interface equipment/software to expand tactical use of national space systems within an operational combat framework as well as to influence the design and operation of new national]]capabilities to improve tactical support. Efforts will include participation in tactical exercises, system interface, software/hardware development, related developmental studies and the development of Congressional Impact Statements for national space systems' major modifications and/or new starts in terms of their tactical combat operations utility.

B. (U) Program Accomplishments and Future Efforts:

(1) FY 1986 Accomplishments: As the lead Service for the Joint Chiefs of Staff (JCS) Special Project 86 NIGHT SURGE, Tactical Exploitation of National Space Program Capabilities (TENCAP) coordinated all Service efforts and funded the development of prototype receive equipment for the exercise. NIGHT SURGE provided tactical forces the opportunity to gain experience in the use of national intelligence systems in a contigent exercise environment. The objectives were[

] Similar support was provided for the upcoming JCS directed Special Project 87 POWER HUNTER. POWER HUNTER,[ ]objectives include the evaluation of the use of: [

] Numerous command unique initiatives were supported, such as the[ ],and the development of a collection management automation system. HQ Air Force projects included a multi-spectral imagery survey, COMPASS CALL C^3 improvements, the development of a Tactical Digital Information Exchange System Broadcast (TADIXS-B) concept of operations and the development of a tactical impact statement of improved national systems. All have led to significant improvements to the tactical utility of national systems.

(2) FY 1987 Program: The primary RDT&E activity planned for FY 1987 is the development of a Tactical Impact Statement on a new national program. Continuing exercise evaluation, software development and interface/connectivity/procedural evaluation/development are also planned. In accordance with Secretary of the Air Force direction, Air Force TENCAP will develop a prototype testbed for the evaluation of CONSTANT SOURCE[

]

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: FY 1988 funding will be used for continuation of ongoing efforts; such as the continuation of studies of methods to locate relocatable targets and the

identification of requirements for use of multi-spectral imagery information; and procedural, software, and hardware development and evaluation in support of Joint Chiefs of Staff (JCS) directed Special Project 88. Special Project 88 will evaluate the combined tactical use of Electronic Intelligence (ELINT) and Communications Intelligence (COMINT) as well as new dissemination techniques. The FY 1988 cost estimates for these activities are based on projections for continuing FY 1987 efforts into FY 1988 and previous completed cost data on support to JCS Special Projects. Additionally, we will expand Operations Test and Evaluation (OT&E) of CONSTANT SOURCE into the theaters to support Major Command requirements.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: FY 1989 funds will be used for proof of concept demonstrations/evaluations/testing of prototype tactical receive/processing equipment.

(5) (U) Program to Completion: Program is managed as a continuing level of effort.

C. (U) Major Milestones:

	Milestones	Dates
(1)	) Relocatable Target Study Complete	
(2)	) P400 Initial Operational Capability	
(3)	( ) Joint Chief of Staff (JCS) Special Project 87	
(4)	(U) Blue Flag Exercise Support	Quarterly
(5)	(U) Green Flag Exercise Support	Quarterly
(6)	(U) Electronic Signal Parametric SON	June 1988
(7)	( ) Constant Source Initial Operational Capability	
(8)	( ) Constant Source Full Operational Capability	
(9)	( ) JCS Special Project 89	
(10)	( ) Multi Spectral Imagery Initial Operational Capability	
(11)	(U) JCS Special Project 91	Open

8. (U) PROJECTS OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 27316F
DOD Mission Area: 224 - Defense Suppression

Title: Tacit Rainbow
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		*	*	164,359**	48,360**	10,700	223,419**

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Services have an urgent need for a low-cost, programmable, loitering missile system that can search out and attack emitting enemy radars and jammers. This missile system will provide commanders with a weapon that can defeat/suppress the enemy's ability to: acquire and attack friendly forces and jam friendly emitters. Both air and surface-launched variants should be developed; maximum commonality of components between the variants is mandatory. The system must interface with existing and planned command, control, communications, and intelligence (C^3I) elements to be compatible with individual and joint Service employment concepts. Tacit Rainbow Full Scale Development is funded under this program element.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: Not Applicable

4. OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total
Aircraft Procurement:						
Funds	*	*	26,900	21,614	11,609	60,123
Quantities (launchers)	*	*				-
Missile Procurement:						
Funds	*	*	55,092	109,361	1,349,454	1,519,007
Quantities	*	*				
Military Construction:						
Funds	*	*	0	4,400	2,943	7,343

* In classified PE
** $71.9M (FY88), $22.0M (FY89) should be transferred to classified programs. Additional information available through appropriate channels.

PE: 27316F

5. (U) RELATED ACTIVITIES: The Tacit Rainbow (TR) program is a tri-Service effort with the Air Force serving as the Executive Service with Army and Navy personnel integrated into the Joint System Program Office (JSPO). The JSPO is maintaining a close relationship with the B-52 program office to assure proper implementation of aircraft modifications required to employ the TR vehicle. The TR vehicle is compatible with AF and Navy tactical aircraft suspension equipment and multiple carriage bomb racks. Funding for Navy peculiar full scale development (FSD) and procurement is included in PE 27316N.

6. (U) WORK PERFORMED BY: The Tacit Rainbow development and acquisition program is being managed by the Tacit Rainbow Joint System Program Office at the Aeronautical Systems Division, Wright-Patterson AFB, OH. In addition to Aeronautical Systems Division, other government organizations participating in the development effort include Air Force Tactical Air Command, Langley Air Force Base, VA; Air Force Strategic Air Command, Offutt Air Force Base, NE; Air Force Logistics Command, Wright Patterson, Air Force Base, OH; Warner Robbins Air Logistics Center, Warner Robins Air Force Base, GA; Naval Air Systems Command, Washington DC; Naval Weapons Center, China Lake, CA; Army Materiel Command, Washington DC; Army Missile Systems, Redstone Arsenal, AL; Dugway Proving Ground, UT. Northrop Corporation, Ventura Division, Thousand Oaks, CA, was selected as the prime contractor for full scale development and initial production of the air-launch vehicles. Contractors will be competitively selected for second source production of the air-launch vehicle.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) PROJECT: 27316F, TACIT RAINBOW

A. (U) Project Description: The Tacit Rainbow development program will significantly increase the Services' capability to suppress enemy air defenses by producing a low-cost, programmable, loitering missile system that can search out and attack emitting enemy radars and jammers. Air-launched Tacit Rainbow vehicles will be compatible with the Air Force B-52 aircraft and Air Force and Navy tactical aircraft (F-16, A-7, A-6E). Using simplified seeker and guidance techniques and state-of-the-art technology, this autonomous weapon system is designed to produce a viable emitter attack capability at a cost significantly less than other anti-radiation attack weapon systems.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Not Applicable.

(2) (U) FY 1987 Program: The critical design review of the air-launch vehicle will be conducted in October. Contractor-conducted development flight tests will precede an Air Force/Navy combined Development Test and Evaluation/Initial Operational Test and Evaluation using the B-52 and A-6E aircraft. An improvement to the missile

seeker is in parallel development to meet joint operational requirements to attack a larger number of target types.

(3) FY 1988 Planned Program and Basis for FY 1988 RDT&R Request: The FY 1988 funding will complete full scale development of the air-launch vehicle. The Joint System Program Office has negotiated a cap of $161 million to the full scale development contract. A twenty-five vehicle Air Force and Navy combined development test and evaluation/initial operational test and evaluation using the Air Force B-52 and Navy A-6E aircraft will be completed. The Air Force and Navy plan to buy a total of [ ] air-launch vehicles, respectively. An independent single best cost estimate completed by the Air Force and Navy in February 1986 and approved by OSD projects a unit production cost of [ ] (FY 85$). A low rate initial production decision is planned for the third quarter with a sole source award to Northrop to produce [ ] missiles. An acquisition strategy is being developed to provide competition for full rate production of the air launch vehicle. The cost estimating confidence level for full scale development is level III and for production is level IV.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The FY 1989 funding will support system enhancements, some of which are expanded seeker capabilities and mission computer performance. Qualification on the F-16 aircraft will begin. Follow-on Operational Test and Evaluation will be supported. The cost estimating confidence level for full scale development is level III and for production is level IV.

(5) Program to Completion: Air Force and Navy production for the air-launch vehicle will be complete in [ ] respectively. FY 1990 will be the first year of rate production of the air-launch vehicle.

C. Major Milestones:

		Milestones	Dates
		Air-Launch Milestones	
(1)	(U)	Milestone III	3rd Quarter FY 1988
(2)	(U)	Complete full scale development	4th Quarter FY 1988
(3)	(U)	First Production Delivery	4th Quarter FY 1989
(4)		Initial Operational Capability	[ ]

9. (U) COOPERATIVE AGREEMENTS: Not Applicabile

Budget Activity: 4-Tactical Programs
Program Element: 27316F, Tacit Rainbow

Test and Evaluation Data

1. (U) Development Test and Evaluation (DT&E): Full scale development of TACIT RAINBOW is being managed by the Joint System Program Office (JSPO) at Aeronautical Systems Division, Wright-Patterson Air Force Base, OH. The Air Force Flight Test Center (AFFTC), Edwards Air Force Base, CA, is the Responsible Test Organization for DT&E. AFFTC will form a Combined Test Force to conduct the combined DT&E and Initial Operational Test and Evaluation (IOT&E). The Air Force Operational Test and Evaluation Center (AFOTEC) will have management responsibility for the dedicated OT&E events scheduled during the combined DT&E/IOT&E.

(U) A sole source contract was awarded to Northrop, Ventura Division, Thousand Oaks, CA, for development of the TACIT RAINBOW system.

Contractor development tests performed to date have consisted of ground and flight tests. The ground tests consisted of environmental, structural, reliability and instrumentation tests. The flight tests consisted of captive, safe separation and missile free flights. These tests demonstrated the ability of the missile to be launched from an aircraft, deploy its wing and control surfaces, start its engine, fly a preprogrammed flight path, acquire the target and terminally guide to that target. [redacted] The tests satisfactorily demonstrated the functional capability of the Block I system design to meet operational requirements. The Block I designation refers to a design which does not meet the full air launch environment from fighter/attack /bomber aircraft and does not include a doppler subsystem or components manufactured to military standards.

(U) The warhead (WDU-30/B) is being developed by the Naval Weapons Center (NWC), China Lake, CA. Engineering development including performance, environmental and safety demonstrations have been completed. Qualification tests of the production design are currently being conducted.

(U) Future testing involves ground tests to fully qualify the missile and flight tests to demonstrate the missile satisfies design specifications and operational requirements. The ground tests to be conducted are: environmental testing (MIL STD) at the Point Mugu Test Center (PMTC), CA; electromagnetic interference testing at PMTC and Naval Strike Warfare Center (NSWC), NV; Hazardous Radiation Effects on Ordnance (HERO) testing at NSWC; explosive qualifi-cation and environmental safety verification tests at NWC; and reliability demonstration tests at PMTC. Other ground tests related to clearing the vehicle for carriage on and release from the B-52G and A-6E aircraft include wind tunnel tests at the Arnold Engineering and Development Center, TN, electromagnetic compatibility testing, pit ejection, and loading/fit checks.

(U) The contractor will evaluate the missile systems performance through a series of captive, jettison, and free flights using the B-52G and A-6E aircraft. The tests will demonstrate safe separation through the aircraft flow field, wing and control surface deployment, engine start, free flight performance and terminal guidance.

Budget Activity: A-Tactical Programs
Program Element: 27316F, TACIT RAINBOW

The combined DT&E/IOT&E flight test program will consist of captive carriage and free flights released from the B-52G and A-6E aircraft. Test missions will stage from Edwards AFB, CA, and use the ranges at the Naval Weapons Center, CA. This series of tests will demonstrate aircraft/missile compatibility and the missiles ability to navigate, acquire and attack an emitting target to include reloiter and reacquisition. Target arrays will increase in complexity throughout the test.

] Twenty-five missiles will be launched during the test with DT&E and IOT&E data collected on each mission. Twenty-four missiles will be equipped with a telemetry/flight termination package. One missile will have a live warhead.

2. Operational Test and Evaluation (OT&E): A combined DT&E/IOT&E will be conducted on TACIT RAINBOW. A B-52G aircraft fitted with a rotary launcher in the bomb bay capable of carrying [TACIT RAINBOW vehicles will be one of the aircraft used in this test program. The Navy will provide an A-6E aircraft for operational testing. Tests will be conducted under the control of the Combined Test Force composed of Air Force and Navy personnel. Test missions will stage from Edwards AFB, CA.

(U) A minimum of 15 missions are planned with IOT&E scenarios. Representative mission profiles will be flown by the launch aircraft and missiles with launches performed at low, medium, and high altitude. The last missile in the 25 missile test series will contain a live warhead; however, the range complex for this mission is to be determined.

(U) During the test, Air Force personnel of representative specialty codes will perform ground/aircraft checkout and loading of the launch equipment and missiles on the B-52. Navy personnel will perform ground checkout and loading on the A-6 aircraft. Navy personnel will also conduct an aircraft carrier (CV) suitability evaluation during the test. If available, a mission planning system representative of that to be used to declare initial operational capability will be used.

(U) Data from a minimum of 12 effective live firing missions will be used to provide an OT&E input to a low rate initial production (LRIP) decision milestone.

(U) Critical operational issues to be evaluated during OT&E are listed below.

(U) Ability to detect, identify and successfully engage threat emitters in an operationally realistic environment.

(U) Ability to guide to a point within the lethal radius of the warhead relative to the target.

(U) System lethality, including terminal guidance and target proximity detection fuze and warhead function, to provide adequate firepower kill (Pfk) in a realistic target environment.

(U) Interoperability with host aircraft and other weapons planned for simultaneous carriage.

(U) Compatibility (physical, functional, electromagnetic) with intended operational environments.

Budget Activity: 4-Tactical Programs
Program Element: 27316F, TACIT RAINBOW

(U) Load time sufficient to support required sortie generation rates.

(U) Availability and flight reliability adequate to provide the required performance.

(U) Logistics reliability adequate and the built-in-test detection accuracy sufficient to achieve the required availability.

3. (U) System Characteristics: The air launch missile is designed to meet the requirements of the Mission Element Need Statement and Joint Systems Operational Requirements (JSOR) for an autonomous defense suppression weapon. The system requirements and thresholds shown below are extracted from the JSOR, system specification and Test and Evaluation Master Plan.

	Characteristics	Objective/Threshold	Demonstrated
a.	Performance		
	Speed (KTAS)		To be demonstrated
	Altitude (feet)		
	launch		
	bomber		To be demonstrated
	fighter		To be demonstrated
	carriage		
	bomber		To be demonstrated
	fighter		To be demonstrated
	Accuracy		
	navigation		
	downrange error		To be demonstrated
	crossrange error		To be demonstrated
	loiter		To be demonstrated
	terminal (ft. CEPn) (4)		
			To be demonstrated
			To be demonstrated
	Range		To be demonstrated
	Kill Probability (%) (5)		To be demonstrated

Budget Activity: 4-Tactical Programs
Program Element: 27316F, TACIT RAINBOW

	Characteristics	Objective/Threshold	Demonstrated
b.	Reliability		
	Mission (7) Pre-launch (8)	[ ]	To be demonstrated To be demonstrated
c.	Missile Description		
	Launch weight (pounds)	| |	
	Guidance	Passive, home-on-emitter	
	Compatibility	B-52G, F-16, A-10, A-7, A-6E (triple ejector rack, multiple ejector rack)	

(1) Minimum continuous, maximum continuous, maximum dash [ ]

(2) (U) Of distance traveled, whichever is greater.

(3) Maintain centroid of programmed pattern within [ ] of desired point at ranges up to [ ] from launch point.

(4) (U) Target at zero feet MSL, 30 knot wind vector. Circular error probable (CEP), normal to missile flight path.

(5) (U) Fire power kill, four hours to repair.

(6) Single shot fire power kill (Pfk) against a [ ] Target at zero feet MSL.

(7) (U) After pre-launch, includes all aspects from carriage through to warhead function.

(8) (U) Defined as passing go/no-go checks and accepting preflight mission programming.

4. CURRENT TEST AND EVALUATION (T&E):

T&E Activity (Past 12 Months)

Event	Planned Date	Actual Date	Remarks
Contractor Flight Test	Dec 85	29 Jan 86	A-7 release, fully successful
Risk reduction effort	Oct 86	Apr 86	Solved low temperature, terminal guidance, safe separation problems
Critical Design Review (CDR)	Oct 86	20 Oct 86	25 of 30 action items resolved (as of 23 Dec 86)
B-52 CDR	Oct 86	27 Oct 86	Bomb bay rotary launcher

T&E Activity (Next 12 Months)

Event	Planned Date	Remarks
Contractor Flight Test	[ ]	4 free flights
Environmental Testing	[ ]	
Start Combined DT&E/IOT&E	[ ]	25 free flights, A-6E and B-52 aircraft

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 27411F
DOD Mission Area: 352 - Air Warfare

Title: Overseas Air Weapon Control System
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		2,844	6,305	6,947	6,075	Continuing	N/A
2026	ETACCS/ACCS	1,300	1,300	0	0	0	7,789
2704	EIFEL Follow-On	1,544	5,005	6,947	6,075	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Elektronisches Information Und Fuhrungsystem Fur Die Ernsatzbereitschaft Der Luftwaffe (EIFEL) system satisfies the requirement for an automated command and control system, for the United States Air Force operated Allied Tactical Operations Center (ATOC) at Sembach, Germany. Under the EIFEL Follow-On (EFO) effort, the United States Air Force will cooperate with the Federal Republic of Germany in the joint development of a follow-on system to augment and expand the current EIFEL I system from the ATOC down to the wing/squadron level. The European Theater Air Command & Control System (ETACCS) has been established to analyze and coordinate the accomplishments of the North Atlantic Treaty Organization (NATO) team working on the NATO Air Command & Control System (ACCS) and to develop United States coordinated positions relative to ACCS issues.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	3,014	8,534	10,905	N/A	Continuing	N/A

EXPLANATION: (U) Difference in FY 1987 is due to Congressional reduction. Difference in FY 1988 is due to ETACCS/ACCS cancellation and DOD/AF reductions.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: HQ United States Air Forces Europe (USAFE) is developing a unit level automation system, known as Wing Command and Control System which will be interfaced to EFO during the FY 1988-90 time frame.

6. (U) WORK PERFORMED BY: The EFO effort is being accomplished by Air Force Systems Command Electronic Systems Division Europe, Kapaun AS, GE. Mitre Corporation, Bedford, MA, is providing technical support in this effort. The German Dornier Corporation is developing software for the ATOC Host System Software.

Program Element: 27411F
DOD Mission Area: 352 - Air Warfare

Title: Overseas Air Weapon Control System
Budget Activity: 4 - Tactical Programs

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2704, EIFEL Follow-On:

A. (U) Project Description: The Elektronischea Information Und Fuhrungsystem Fur Die Ernsatzbereitschaft Der Luftwaffe (EIFEL) system provides an automated capability for the command and control of tactical offensive air functions in the Central Region of North Atlantic Treaty Organization. The current EIFEL I system provides an initial capability at the Allied Tactical Operations Center (ATOC) but does not provide automation at the unit level or the communication network necessary to provide interoperability, succession of command and survivability. EIFEL Follow-On (EFO) will correct these deficiencies.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: In FY 1986, a Memorandum of Understanding (MOU) for EFO between the United States (US) and the Federal Republic of Germany (FRG) was negotiated and signed. Also, the joint US/FRG Program Office in Bonn, Germany, with Mitre support, initiated planning for development of ATOC improvements and continued development of the ATOC Host Standard Software (HSS).

(2) (U) FY 1987 Program: In FY 1987, the HSS development will continue, consuming most of the funding. Planning and initial development activities, for an expanded ATOC system, will continue. The MOU will be amended to add the United Kingdom, Belgium, and the Netherlands to the program.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: In FY 1988, the HSS will be installed and planning will be initiated for a distributed network interfacing all the Central Region ATOCs and Wing Operations Centers (WOC). An interface between EIFEL and the Wing Command and Control System (WCCS) will be developed. In addition, development of ATOC improvements will continue, including integrating a Force Level Planning System into EIFEL. This is a Category III, Budgetary, cost estimate.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: In FY 1989, development of ATOC improvements will continue. The EIFEL/WCCS interface will be installed. A new central processing unit for the ATOC level system will be installed. Also, development of the distributed network between Central Region ATOCs and WOCs will be initiated. This is a category III, Budgetary, cost estimate.

(5) (U) Program to Completion: This is a continuing program. The distributed network and ATOC improvements development will continue until FY 1990. A multi-level security capability will be developed in FY 1991-92.

C. (U) Major Milestones:

	Milestones	Dates
(1) (U)	Amended MOU Signature	May 1987
(2) (U)	HSS Development Complete	December 1987
(3) (U)	HSS Installation Complete	June 1988

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable

9. (U) COOPERATIVE AGREEMENTS: A Memorandum of Understanding (MOU) between the United States (US) and the Federal Republic of Germany (FRG) was signed in June 1986 for the Cooperative Software Development and Implementation for the Elektronisches Information Und Fuhrungsystem Fur Die Ernsatzbereitschaft Der Luftwaffe (EIFEL) System. Total US contribution will not exceed 50 million Deutsch Marks. The German Dornier Corp was awarded the contract for the software development in 1985. The exact US share of the costs for this contract is yet to be determined. The current estimate is approximately $10 million FY 86-FY 88, at the current exchange rate. Initial operating capability is projected for Jun 1988. The MOU is being modified to include the United Kingdom, Belgium, and the Netherlands.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 27412F
DOD Mission Area: 352 - Air Warfare

Title: Tactical Air Control System (TACS)
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		17,142	18,546	20,995	14,370	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Tactical Air Forces require development of a highly reliable, positive control system to fully exploit the inherent capabilities of tactical air power. The Tactical Air Control System (TACS) provides the means through which the Air Component Commander exercises control of his forces to accomplish his assigned mission. This program provides for major improvements to the existing TACS which was deployed in the sixties and is nearing the end of its useful life. Some of the programs include developing a new transportable modularized, software intensive, automated air command and control system and a series of electronic countermeasure programs to enhance the survivability and capabilities of the AN/TPS-43E surveillance radar. The TACS Improvement RDT&E program consists of the following efforts:

- Modular Control Equipment (MCE)
- MCE Preplanned Product Improvement (P^3I) Program
- Anti-Radiation Missile (ARM) Alarm Sensor
- ARM Decoy

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	14,566	19,261	41,694	N/A	Continuing	N/A
Other Procurement	104,476	85,069	202,397	N/A	Continuing	N/A

EXPLANATION: (U)
- FY 1986: $2,576 thousand RDT&E net increase due to reprogramming to develop additional communications interfaces. Since development of the Ultra-Low Sidelobe Antenna (ULSA) is now complete, procurement funding is no longer shown in this descriptive summary. Procurement shows a reduction in all years due to this.
- FY 1987: $20,745 thousand net procurement reduction due to Congressional budget cuts and ULSA funding no longer being shown.
- FY 1988: $20,699 thousand RDT&E net reduction due to MCE P^3I rephasing. $52,542 thousand procurement net reduction due to MCE rephasing and ULSA funding no longer being shown.

4. (U) OTHER APPROPRIATION FUNDS ($ in thousands):

		FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Other Procurement:							
Funds:		72,172	61,912	149,855	174,136	Continuing	N/A
Quantities:	ARM Alarm	0	0	2	36	27	
	ARM Decoy	0	0	0	0	65	
	MCE	2	2	9	10	132	

5. (U) RELATED ACTIVITIES: The Modular Control Equipment (MCE) program is a joint program with the United States Marine Corps (USMC) Tactical Air Operations Module (TAOM) program (PE 26626M). The TAOM/MCE contract is administered by the USMC Systems Project Office based on a 1982 Memorandum of Agreement between the Navy and Air Force. The MCE Preplanned Product Improvement (P^3I) program will integrate the Joint Tactical Information Distribution System Class 2 Terminals (PE 64771D and 64754F), provide secure anti-jam VHF radios via the Single Channel Ground and Airborne Radio System (SINCARS) program (PE 27423F), and the Ground Attack Control Capability (GACC). Using the specially developed software adaptation, MCE will use information from the Joint Surveillance and Target Attack Radar System (J-STARS, PE 64770F), the Advanced Synthetic Aperature Radar System (ASARS), and other intelligence sensors to provide immediate interdiction command and control against time sensitive ground targets. This program is closely related to the Advanced Command and Control Development program (PE 63789F) which does advanced development work for the TACS. The Fiber Optics Advanced Development program (PE 63726F) did advanced development work for Tactical Generic Cable Replacement (TGCR) and the Joint Tactical Communications program (TRI-TAC) (PE 28010F) will continue Full Scale Development and production of TGCR. TGCR will be used to replace the heavy 26-pair copper wire cables currently used by the TACS.

6. (U) WORK PERFORMED BY: Electronic Systems Division, Hanscom Air Force Base, MA, manages this program. Tactical Air Command, Langley Air Force Base VA, provides operational support, and MITRE Corp., Bedford, MA provides systems engineering. Major contractors include: Litton Data Systems Van Nuys, CA, for MCE; Sanders Associates, Nashua, NH, for Anti-Radiation Missile (ARM) Alarm Sensor; ITT Corporation, Van Nuys, CA, Aydin Corporation, San Jose, CA, and LTV Corporation, Buffalo, NY for ARM Decoy.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 27412F, Tactical Air Control System (TACS).

A. (U) Project Description: The TACS program includes several ongoing research and development programs. The Modular Control Equipment (MCE) will provide modular replacement units for the aging and obsolete operations shelters and ancillary equipment at the Control and Reporting Centers/Control and Reporting Posts and Forward Air Control Posts

of the TACS. It will greatly increase weapons control capability, enhance the TACS survivability, mobility, and transportability, and handle the greatly increased command, control, and communications workload required in modern tactical combat scenarios. The Modular Control Equipment (MCE) Preplanned Product Improvement (P^3I) Program will incorporate phased improvements to the basic MCE system so that MCE capabilities keep pace with the changing TACS environment. The Ultra-Low Sidelobe Antenna (ULSA), the Anti-Radiation Missile (ARM) Alarm Sensor, and the ARM Decoy (collectively known as SEEK SCREEN) are three efforts to enhance the survivability and effectiveness of the AN/TPS-43E radar. The ULSA program provides a new antenna for the AN/TPS-43E radar that reduces its susceptibility to ARM lock-on, and significantly increases its capability against jamming (ULSA development is complete). The ARM Alarm program will provide the capability to detect approaching ARMs in time to automatically initiate appropriate counter-actions. The ARM Decoy will provide the means to lure incoming ARMs away from the radar. The Ground Attack Control Capability (GACC) is a software package that will provide the TACS with timely command and control of attacks against time-sensitive mobile ground targets (deep air interdiction). The GACC will employ MCE hardware.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: The Full Scale Development (FSD) contract for the ARM Decoy was signed on 30 June 1986 to take three contractors through Initial Operational Test and Evaluation (IOT&E). Conceptual design work continued on the MCE P^3I program, including GACC and Joint Tactical Information Distribution System (JTIDS) integration. Field Development Test and Evaluation (DT&E) was completed and IOT&E started on the MCE. Phase II of Air Force IOT&E was completed in August 1986. The final MCE production request for proposal was released. The ARM Alarm program completed field DT&E, but was delayed in completing in-plant DT&E.

(2) (U) FY 1987 Program: ARM Decoy FSD will continue and the MCE P^3I will be initiated with FSD contract award scheduled for February 1987. ARM Alarm DT&E and IOT&E will be completed and source selection started. The MCE production contract will be awarded using FY 1986 and 1987 combined funds (low-rate initial production for 4 units). The ARM Decoy will complete system design and begin system integration/engineering model construction. MCE P^3I will begin intensive software design for the GACC and JTIDS integration, including Tactical Data Link - J (TADIL-J) message formating. Other Block 1 P^3I includes automated air tasking order software design and coding, and design work on the Ground Mobile Forces (GMF) satellite and TRI-TAC AN/TRC-170 troposcatter radio interface for the MCE. The ARM Alarm will complete Initial Operational Test and Evaluation (IOT&E) in February 1987 leading to a production request for-proposal (RFP) in April 1987 and contract award in FY 1988.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: In FY 1988, development work on the ARM Decoy will be completed and combined DT&E and IOT&E will be started. The three competing contractors will be evaluated on the basis of best technical solution and competitive cost proposals submitted for production. The production RFP will be released in FY 1988. The MCE P^3I program will continue full scale development work. Level II drawings and hardware design will be completed. Software coding work for the Ground Attack Control Capability (GACC), Joint Tactical Information Distribution System (JTIDS), and Automated Air Tasking Order (AATO) efforts under P^3I will be approaching 60 percent completion. In addition to software coding, the JTIDS effort will continue work on the electrical interface/integration work with the class 2H terminal. Work on other electrical interfaces will continue,

including electrical design, and software coding changes will be incorporated into the Modular Control Equipment (MCE) software. The MCE will enter full-scale production with 9 units programmed for the FY 1988 buy. The Anti-Radiation Missile (ARM) Alarm production contract will be awarded for the first-article unit and follow-on production options. The cost estimates for the MCE and ARM Decoy are Category II, mature, and the ARM Alarm and MCE Preplanned Product Improvements (P^3I) are Category III, budgetary, estimates. These are current and valid estimates.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The FY 1989 program will complete combined developmental and operational testing for the ARM Decoy. Contract proposals from the three competing contractors funded through Initial Operational Test and Evaluation (IOT&E) will be received and contract fact-finding and negotiations will be initiated for an FY 1989 contract award to the contractor with the best technical and cost solution. ARM Alarm production will continue with 36 units programmed. The MCE P^3I Block 1 development will be essentially complete and in-plant testing initiated. Preliminary design work will be initiated on Block 2 of P^3I, which will include expanding the MCE system display grid, expanding the MCE data link capability, interfacing the Combat Identification System-Indirect Subsystem (CIS-ISS) with the MCE, and adding internal radio remoting and expanded data recording. The cost estimates for MCE and ARM Decoy are Category II, mature, and the ARM Alarm and MCE P^3I estimates are Category III, budgetary. These are current and valid estimates.

(5) (U) Program to Completion: This is a continuing program. Full scale production of the ARM Decoy will be be initiated and continue through FY 1993. ARM Alarm production will continue to completion in FY 1991 after procuring 65 units. MCE will continue production with the buyout of 155 units. MCE P^3I will continue with Block 2 developments as described above, and include initial design studies for additional MCE interfaces (Milstar, Operations Intelligence Interface (OII), the Joint Surveillance and Target Attack Radar System (J-STARS), and the Advanced Tactical Surveillance System (ATSS) being developed in Program Element (PE) 63789F. MCE P^3I will provide the vehicle for evolutionary improvements to the TACS equipment to be fielded in the 1990s so that it will be interoperable and compatible with new sensors and command and control systems fielded in the same timeframe or later, but insufficiently defined for inclusion in the production MCE. P^3I requirements and approval are validated in Program Management Directive 2023()/27412F.

C. (U) Major Milestones:

PROGRAM	R&D CONTRACT AWARD	START IOT&E	PRODUCTION AWARD	INITIAL DELIVERY
(1) (U) ARM Alarm	Jun 83	(Jul 86) Jan 87	(Dec 86) FY 88	(FY 89) FY 90
(2) (U) ARM Decoy	(Feb 86) Jun 86	(1Q FY 88) Jul 88*	(FY 89) FY 90	(FY 90) FY 91
(3) (U) MCE	Jul 82	(Apr 86) Jun 86	(Sep 86) Apr 87	FY 90
(4) (U) MCE P^3I	(Feb 85) Feb 87	FY 90	N/A	(FY 90) FY 92

- Anti-Radiation Missile (ARM) Alarm Sensor
- ARM Decoy
- Modular Control Equipment (MCE)
- MCE Preplanned Product Improvement (P^3I) Program

Program Element: 27412F
DOD Mission Area: 352 - Air Warfare

Title: Tactical Air Control System (TACS)
Budget Activity: 4 - Tactical Programs

() Indicates date presented in FY 1987 Descriptive Summary.
* Combined Development Test and Evaluation (DT&E)/Initial Operational Test and Evaluation (IOT&E).

(U) Explanation of Milestone Changes

(1) (U) In-plant Anti-Radiation Missile (ARM) Alarm DT&E delayed due to environmental test failure--now corrected; contract award date slipped nine months due to Congressional cut of FY 1987 procurement funds.
(2) (U) Full-Scale Development (FSD) ARM Decoy contract award delayed five months due to change in acquisition strategy to incorporate competition (three contractors); testing schedule adjusted to accommodate three-contractor program; one year slip in production contract award and initial deliveries due to addition of three contractors through FSD.
(3) (U) MCE IOT&E start delayed two months to allow retesting in DT&E; MCE Production contract award delayed three months due to testing delay and corrections to the initial request for proposal released in April 1986, and three additional months for program restructuring following budget cuts.
(4) (U) Previous milestone (Feb 85) was for preliminary development; Feb 87 is for FSD contract. IOT&E slipped six months and deliveries slipped fifteen months due to change in P^3I acquisition strategy. Change in acquisition strategy decouples P^3I from MCE production contract and incorporates enhancements by production engineering change proposals.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 27417F
DOD Mission Area: 352 - Air Warfare

Title: Airborne Warning and Control System
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		105,210	96,762	110,737	88,419	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program develops and integrates system improvements which will enable the E-3 to remain an effective, survivable airborne surveillance system for command and control of tactical forces and for strategic defense of the United States. The E-3 Airborne Warning and Control System (AWACS) overcomes ground-based surveillance system deficiencies through its unique ability to provide extended all altitude surveillance and, for the first time, the means to manage the air battle in real time. The AWACS contributes significantly to the effective use of United States (U.S.) forces supporting the North Atlantic Treaty Organization (NATO), the air defense of the U.S. and worldwide commitments.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	118,762	137,190	117,842	N/A	186,000	2,255,608

Explanation: (U) FY 1986 shows the effects of Gramm-Rudman and revised inflation indices. FY 1987 reflects distributed and undistributed Congressional reductions. FY 1988 reflects a constrained budgetary environment.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
Aircraft Procurement: Funds (Class V Mod Kits) includes initial spares	0	36,100	22,100	31,500	542,600	632,400

5. (U) RELATED ACTIVITIES: The E-3 upgrade program draws equipment from several development programs. The Joint Tactical Information Distribution System (JTIDS) Class 2 terminal required for the Tactical Data Information Link J (TADIL J) standard message format is developed under PE 64771D, Common JTIDS. The E-3 interoperability test equipment requirements are funded in PE 64779F, Joint Interoperability of Tactical Command and Control Systems (JINTACCS). Development and integration of the Global Positioning System (GPS) user equipment is funded in PE 35164F, Navstar GPS User Equipment. HAVE QUICK improvements and development/integration of Single Channel Ground and Airborne Radio System (SINCGARS) are funded within PE 27423F, Advanced Communications Systems. Development and integration of the improved Identification Functional Group is funded in PE 64725F, Combat Identification Systems.

Program Element: 27417F
DOD Mission Area: 352 - Air Warfare

Title: Airborne Warning and Control System
Budget Activity: 4 - Tactical Programs

6. (U) WORK PERFORMED BY: The Electronic Systems Division (ESD) at Hanscom AFB, MA manages the U.S. program. ESD and the NATO Airborne Early Warning and Control Program Management Agency (NAPMA), Brunssum, Netherlands, jointly manage the Electronic Support Measures (ESM) cooperative development program. The major contractors are the Boeing Aerospace Company, Seattle, WA (air vehicle and integration); Westinghouse Electric Corporation, Baltimore, MD (radar); International Business Machines, Owego, NY (Data Processor); Singer Kearfott Corporation, Little Falls, NJ (Communications and Joint Tactical Information Distribution System (JTIDS) Digital Data Link); UTL Corporation, Dallas, TX (Electronic Support Measures Equipment).

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: PE 27417 Airborne Warning and Control System (AWACS)

A. (U) Project Description: The E-3 AWACS supports tactical air force and continental air defense force operations. AWACS overcomes the range, vulnerability, low altitude target detection, and electronic countermeasures deficiencies of present ground-based radar systems. It provides command and control functions for the Tactical Air Forces during deployment, counterair, interdiction, rescue, and airlift missions. AWACS provides command and control functions for strategic defense of the continental United States. It can be employed at any level of conflict. This Boeing 707 derivative contains radar, communications, identification sensors, and processors which provide an integrated air situation display at the operator consoles. Planned improvements will continue to exploit the AWACS's inherent capabilities and keep pace with the evolving threat. These improvements include Electronic Support Measures (ESM), Tactical Data Information Link J (TADIL J) with computer memory upgrade, and the NAVSTAR Global Positioning System (GPS) (collectively known as Block 30/35) as well as Mark XV and HAVE QUICK. Block 30/35 development will be under a single integrating contractor and retrofit will be accomplished as a single package. This will provide for significant efficiencies in system development and scheduling of test assets, and will also minimize operational aircraft downtime during retrofit. ESM will provide a passive detection, location, and identification capability against airborne, shipborne, and ground-based emitters. TADIL J will provide secure, jam-resistant communications with the fighter force. The GPS system will replace the Omega navigation equipment and will provide more accurate position and velocity information to support command and control. The Mark XV IFF will provide a secure, anti-jam IFF capability and eliminate current anomalies such as the E-3 IFF jitter and mode/code availability and reliability problems. HAVE QUICK A-NET, a communications electronic counter-counter measures improvement, provides more radios and permits simultaneous operation. HAVE QUICK IIA will provide faster frequency hopping radios.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: HAVE QUICK A-NET full scale development (FSD) continued. The Improved Radar Data Correlator (IRDC) validation efforts and the Trainer External Simulation System (TESS) FSD continued. E-3 HAVE QUICK IIA improvement integration studies and pre FSD activities for the Block 30/35 Class V modification began.

(2) (U) FY 1987 Program: Improved Radar Data Correlator (IRDC) validation efforts will be completed. Full scale development of the IRDC and the Improved Radar Control and Maintenance Console are deferred due to fiscal constraints. Trainer External Simulation System (TESS) full scale development (FSD) will continue. HAVE QUICK A-Net FSD will continue while Block 30/35 FSD begins. Studies will also begin on the application of Very High Speed Integrated Circuits (VHSIC) for the E-3.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: HAVE QUICK A-Net efforts are scheduled to complete. Trainer External Simulation System (TESS) FSD will be completed. HAVE QUICK IIA FSD will begin. Block 30/35 activity will include the system Preliminary Design Review (PDR). Mark XV Identification Friend or Foe (IFF) integration studies are also scheduled to begin for the improved Identification Functional Group. All estimates are Category III budgetary cost estimates. Estimates for these FSD programs were reviewed in September 1986 and are based on program office estimates with contractor engineering and proposal inputs.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Full scale development for Block 30/35 will continue. A system Critical Design Review will occur. The Electronic Support Measures (ESM) system will complete engineering test and evaluation and will begin flight testing. HAVE QUICK IIA FSD will be completed. All FY 1989 estimates are Category III budgetary cost estimates.

(5) (U) Program to Completion: ESM will complete Initial Operational Test and Evaluation and full scale development in FY 1990. Tactical Data Information Link J (TADIL J) FSD will complete in FY 1991. System level testing of ESM and TADIL J as part of Block 30/35 will complete by FY 1991. E-3 involvement in and support of TADIL J Development Certification Testing will end by FY 1991. Block 30/35 full scale development will complete in FY 1991 with some residual task support in FY 1992.

C. (U) Major Milestones:

		Milestones		Date
(1)	(U)	E-3A Engineering Development Contract Award		July 1970
(2)	(U)	Start of E-3 production		March 1975
(3)	(U)	Interim Operational Capability (Core Configuration)		April 1978
(4)	(U)	E-3A Standard Configuration Flight Test Complete		October 1981
(5)	(U)	Command and Control Improvements (Block 20/25) Flight Test Complete		March 1984
(6)	(U)	Last Production Aircraft Delivered		June 1984
(7)	(U)	Improved Radar Data Correlator (IRDC) Validation Phase Complete	*(August 1986)	May 1987
(8)	(U)	HAVE QUICK A-Net Flight Test Complete		September 1987
(9)	(U)	Trainer External Simulation System (TESS) Installation Complete	*(October 1987)	April 1988
(10)	(U)	Electronic Support Measures (ESM) Flight Test Complete	*(January 1989)	December 1989
(11)	(U)	Tactical Data Information Link J (TADIL J) Flight Test Complete	*(April 1989)	November 1990

Program Element: 27417F
DOD Mission Area: 352 - Air Warfare

Title: Airborne Warning and Control System
Budget Activity: 4 - Tactical Programs

Milestones	Date
(12) (U) Block 30/35 Flight Test Complete	*(August 1990) November 1990
(13) (U) Block 30/35 Functional/Physical Configuration Audits (FCA/PCA) Complete	March 1991

* Data presented in FY 1987 Descriptive Summary.

(U) Explanation of Milestone Changes

(7) (U) Slip in Improved Radar Data Correlator (IRDC) validation phase due to subcontractor level software problems and the addition of an off-the-shelf feasibility study.
(9) (U) Slip in Trainer External Simulation System (TESS) installation/checkout due to engineering changes and unresolved claims.
(10) (U) Electronic Support Measures (ESM) flight test completion delayed due to slip in start of Block 30/35 full scale development (FSD) and refinement of program schedule.
(11) (U) Delayed due to slip in start of Block 30/35 FSD and refinement of program schedule.
(12) (U) Delayed due to slip in start of Block 30/35 FSD and refinement of program schedule.

9. (U) COOPERATIVE AGREEMENTS: The United States (U.S.) and the North Atlantic Treaty Organization (NATO) will jointly develop and integrate a common ESM package for U.S. and NATO E-3 aircraft. Program management and coordination arrangements are outlined in the E-3 ESM Cooperative Research and Development Agreement. NATO participation consists of the thirteen member nations of the NATO Airborne Early Warning and Control Program Management Organization (NAPMO). Boeing Aerospace Company, Seattle, WA, is the prime contractor the ESM integration, and UTL Corporation, Dallas, TX, is the major U.S. vendor for the Electronic Support Measures equipment. Foreign contractor involvement is planned, but the contractors have not been selected. ESM full scale development (FSD) will begin in FY 1987 as part of the Block 30/35 upgrade of the U.S. E-3 aircraft. Total FSD cost is estimated at $150 million with the NATO share being approximately $50 million.

Budget Activity: 4, Tactical Programs
Program Element: 27417F, Tactical Airborne Command and Control System (E-3A)

Test and Evaluation Data

1. (U) Development Test and Evaluation (DT&E): The E-3A DT&E test program was combined with Initial Operational Test and Evaluation (IOT&E) test objectives in as realistic an operational environment as possible. The prime development contractor is The Boeing Company, and Air Force management is provided by Electronic Systems Division (ESD), Hanscom AFB, MA. The overall objectives of the test effort were to: (a) validate/verify E-3A performance in accordance with design specifications; (b) determine E-3A performance and capability to fulfill operational requirement including interservice interoperability demonstrations; and (c) verify Air Force capability to support the E-3A with standard operational maintenance, logistics and training units using prescribed procedures.

(U) The first phase of three DT&E phases used a Brassboard engineering model and tested the airworthiness of the rotodome, demonstrated the feasibility of competing overland radar technologies (Hughes and Westinghouse) and demonstrated successful integration of radar targets and computer display equipment. Phase I was flown from March through November 1972, and resulted in Westinghouse being selected to continue radar development.

(U) The Systems Integration Demonstration (Phase II) demonstrated successful integration of a single suite of mission avionics which was tested in an electronic countermeasures environment. These tests were flown from March through October 1974 and met or exceeded the performance demonstrated during the Brassboard phase. Test results from the systems integration demonstration phase provided the basis for a production decision.

(U) Phase III was planned to complete air-vehicle, climatic, and mission avionics qualifications and acceptance testing of the core configured E-3A. Three development aircraft and the first production aircraft were flown during this phase from August 1975 through January 1977.

2. (U) Operational Test and Evaluation (OT&E): The E-3A test program has been conducted as a combined DT&E/IOT&E.

(U) Core E-3A Follow-on Operational Test and Evaluation

(U) General. The E-3A test program was conducted as a combined DT&E/IOT&E. ESD is responsible for DT&E. TAC, the operational command, is responsible for conduct of E-3 enhancement IOT&E. AFOTEC monitors the IOT&E program.

(U) Core E-3A Follow-on Operational Test and Evaluation (FOT&E). FOT&E, initiated in January 1977, was conducted in two phases with operational crews using production aircraft, training equipment, and support equipment.

Budget Activity: 4, Tactical Programs
Program Element: 27417F, Tactical Airborne Command and Control System (E-3A)

(U) Follow-on Operational Test and Evaluation (FOT&E) Phase I, managed by the Air Force Operational Test and Evaluation Center (AFOTEC), was completed in February 1978. The results of the first phase of FOT&E were reported in the AFOTEC Airborne Warning and Control System (AWACS) FOT&E Phase I Final Report, July 1978. Test results confirmed that the production E-3A can effectively and efficiently perform its prescribed mission and that the E-3A will greatly enhance the capability of the Air Force to conduct tactical air operations. However, several significant reliability and maintainability problems and deficient logistic support areas were identified for improvement.

(U) FOT&E Phase II, managed by the Tactical Air Command, was initiated in March 1978 to refine initial operational test and evaluation (IOT&E) and Phase I FOT&E assessments with emphasis on tactics and procedures. This testing was completed during May 1980. Test reporting by the United States Air Force Tactical Fighter Weapons Center was accomplished in two parts. Part A of the final report covering the period March 1978 - May 1979 was published in May 1980 titled, Volume I, E-3A Airborne Warning and Control System (AWACS) Follow-on Operational Test and Evaluation (FOT&E), Phase II. Part B was published in October 1980 titled, Volume II, E-3A Airborne Warning and Control System (AWACS) Follow-on Operational Test and Evaluation (FOT&E), Phase II. A separate built-in-test/fault-isolate test report by the United States Air Force Tactical Fighter Weapons Center was published in June 1981 titled, Final Report, E-3A Surveillance Radar Built-In-Test (BIT)/Fault-Isolate-Test (FIT) Evaluation.

(U) E-3 Enhancements IOT&E

(U) Decision Coordinating Paper (DCP) 5, Revision 3, 5 March 1976, approved continued production of the E-3A, and the development of a selected set of system enhancements chosen to provide a fully effective worldwide force. The enhancements were to be developed as separate entities and integrated into the E-3A for testing as the enhancement items became available. In May 1976, the Deputy Secretary of Defense directed the Air Force to plan for an Office of the Secretary of Defense (OSD) review of the AWACS enhancement program when the respective enhancement development efforts are essentially completed. He further stated that it is contemplated that the Defense Systems Acquisition Review Council (DSARC) would then review development and test status and consider the operational utility of the respective enhancements in light of an updated threat evaluation prior to committing the government to production. The purpose of operational testing of the enhancements was to provide an evaluation of the operational utility of each enhancement for the DSARC review. In December 1978, the North Atlantic Treaty Organization (NATO) signed an agreement with the US Government (as their agent) for the procurement of 18 E-3A aircraft. To support this commitment and the US standard configured E-3A aircraft, the Air Force received approval of the OSD for limited production authority for a maritime surveillance capability (MSC) radar and a Joint Tactical Information Distribution System (JTIDS) capability in E-3 DCP, No. 5, Revision IV, 6 March 1980. Results of the JTIDS test were reported in the December 1978 Air Force Test and Evaluation Center (AFTEC) E-3A Joint Tactical Information Distribution System (JTIDS) Adaptable Surface Interface Terminal Initial Operational Test and Evaluation Report. The IOT&E of the US Standard E-3A and the Continental United States portion of the NATO E-3A was conducted by the Air Force Test and Evaluation Center (AFTEC) from 15 September through October 1981. The results of this effort were reported in the AFTEC US/NATO E-3A IOT&E Final Report, March 1982. Overall operational effectiveness and suitability were satisfactory and the US/NATO E-3A, as tested, supported the user's operational requirements.

Budget Activity: 4, Tactical Programs
Program Element: 27417F, Tactical Airborne Command and Control System (E-3A)

(U) The Block 20/25 Modification program retrofits Block 01 (Core) and Block 10 (Standard) configured E-3As. Block 20 will consist of Block 01 plus Joint Tactical Information Distribution System (JTIDS), computer modification, 1 high frequency (HF) radio, 5 ultra-high frequency (UHF) radios, and 5 situation display consoles (SDCs). Block 20 aircraft have been redesignated E-3B aircraft. Block 25 will consist of Block 10 plus 5 UHF radios and 5 SDCs. Block 25 aircraft have been redesignated E-3C aircraft. Initial operational test and evaluation (IOT&E) of the Block 20/25 configuration is not required due to similarity with the Block 10 configuration which has completed operational tests.

The Electronic Support System (ESS) has been installed in the E-3 to

The ESS consists of hardware developments and software modifications. The hardware

The software modifications permit the AWACS Airborne Operational Computer Program

Since ESS was a Quick Reaction Capability (QRC) program, a comprehensive DT&E was not planned. IOT&E for ESS was conducted in two phases by Tactical Air Warfare Center (TAWC) between 18 April 1984 and 7 December 1984. Phase I tested ESS installed on the Core E-3, and Phase II tested ESS installed on the Standard E-3. Each phase had three segments:

Segment 1 - Accomplished by Det 1 USAFTAWC, Seattle, WA,

Segment 2 - Conducted using operationally qualified 552 Airborne Warning and Control Wing (AWACW) personnel

Segment 3 - Conducted using operationally qualified 552 AWACW personnel

Observations identified in the IOT&E end-of-test report were

Significant findings of the test included:

Budget Activity: 4, Tactical Programs
Program Element: 27417F, Tactical Airborne Command and Control System (E-3A)

The IOT&E planned for April 1986 will be conducted in November and December 1986. Availability of the DT&E fixes and operational resource constraints were the principal causes for the test delay. The IOT&E will be conducted in two parts. Part one involves testing using Nellis AFB Nevada ranges. Part two addresses ESS effectiveness

(U) The HAVE QUICK A-Nets modification program will retrofit Block 20 E-3B and Block 25 E-3C configured aircraft to incorporate a full HAVE QUICK capability for eight ultra high frequency (UHF) radios per aircraft. HAVE QUICK provides an air-to-air and air-to-ground jam resistant UHF voice communications capability. HAVE QUICK A-Nets is a Quick Reaction Capability (QRC) program. IOT&E objectives will be accomplished in conjunction with the DT&E effort currently scheduled from May to September 1987.

(U) The Block 30/35 modification will retrofit Block 20 E-3B and Block 25 E-3C aircraft. This mod block update consists of Electronic Support Measures (ESM), Tactical Data Information Link J (TADIL-J) with computer memory upgrade, and the Navstar Global Positioning System (GPS). ESM will be managed jointly with the North Atlantic Treaty Organization (NATO) as a Cooperative Research and Development program for integration of a common ESM system onboard US and NATO E-3 aircraft. IOT&E for the Block 30/35 modifications is planned in two phases: Phase I IOT&E of the US/NATO ESM system, and; Phase II IOT&E for the remaining US Block 30/35 upgrades. Block 30/35 FSD full scale development contract award is planned for FY 1987. Phase I IOT&E is planned for FY 1989 and Phase II IOT&E is planned for FY 1990.

(U) Published OT&E Reports:

(1) <u>AWACS IOT&E Final Report</u>, November 1974, (S).

(2) <u>AWACS Free Play Test</u>, June 1975, (S).

(3) <u>AWACS Special IOT&E</u>, July 1975, (S).

(4) AWACS Phase III IOT&E Final Report, September 1977, (S).

(5) AWACS FOT&E Phase I Final Report, July 1978, (S).

(6) E-3A Joint Tactical Information Distribution System (JTIDS) Terminal IOT&E Final Report, December 1978 (S)

(7) Vol I, E-3A, AWACS FOT&E Phase II, May 1980, (S).

(8) E-3A Maritime Surveillance Capability (MSC) Preliminary Operational Effectiveness Assessment Report, October 1980, (S).

(9) Vol II, E-3A AWACS FOT&E, Phase II, March 1981, (S).

(10) Final Report, E-3A Surveillance Radar Built-in-Test (BIT)/Fault-Isolate-Test (FIT) Evaluation, June 1981, (U)

(11) US/NATO E-3A IOT&E Final Report, March 1982, (S).

3. (U) System Characteristics:

(U) Comparison: Core, Standard, Block 20, and Block 25 Configurations

(U) General:	E-3A/CORE	E-3A/STANDARD	E-3B/BLK 20	E-3C/BLK 25
Crew Size	17	17	22	22
Maritime Radar Capable	NO	YES	PARTIAL	YES
Joint Tactical Information Distribution System (JTIDS) Capable	NO	YES	YES	YES
(U) Hardware:				
Consoles	9	9	14	14
Ultra High Frequency (UHF) Radios	14*	14*	19**	19**
High Frequency Radios	2	3	3	3
Very High Frequency/Amplitude Modulation Radios	3	3	3	3
Very High Frequency/Frequency Modulation Radios	1	1	1	1

* Provides 8 mission UHF nets
** Provides 13 mission UHF nets

Budget Activity: 4, Tactical Programs
Program Element: 27417F, Tactical Airborne Command and Control System (E-3A)

Capability:

	E-3A/CORE	E-3A/STANDARD	E-3B/BLK 20	E-3C/BLK 25
Radar Targets/Scan				
Identification Friend or Foe Targets/Scan				
Data Processing Track Capacity				
Data Processing Simultaneous Intercept				

(U) Comparison: E-3A Core (Block 01) Requirements to Demonstrated Performance

Technical Characteristics:	E-3A CORE REQUIREMENTS	DEMONSTRATED PERFORMANCE
Detection Range (0.9 Probability in 1 Minute)		
High Altitude Bomber (Nautical Miles)		
Low Altitude Fighter Over Land (Nautical Miles)		
Crew Size	17	17
System Track Capacity		
Simultaneous Intercepts		
Targets Position Accuracy (Nautical Miles)		
Time on Station at 1000 Nautical Miles from Base in hours	6.1	6.2

(U) Reliability and Maintainability Characteristics:

Probability of Completing 9 Hour Mission	0.88	0.88
Maintenance Manhour/Flight Hour	28.0	33.9*
In-Commission Rate	80%	95.7%
Probability of Fault Detection	95%	97%
Probability of Fault Isolation (To 3 Primary Units)	90%	95%
Turn Around Time	90% in 5.5 hrs	90% in 4.8 hrs
Probability of not Detecting Failure	0.08	0.03

*Actual data experienced during FY 1984 for all E-3A aircraft (includes Core and Standard configurations) delivered to Tactical Air Command.

Budget Activity: 4, Tactical Programs
Program Element: 27417F, Tactical Airborne Command and Control System (E-3A)*

(U) Comparison: E-3A Standard (Block 10) Design Requirements to Demonstrated Performance

Technical Characteristics:	THRESHOLD	GOAL	DEMONSTRATED PERFORMANCE
Maritime Surveillance Capability			
Maximum Detection Range (Nautical Miles)			
Fast Patrol Boat			
Destroyer			
Maritime Targets Tracking Accuracy			
Position (Nautical Miles)			
Heading (Degrees)			
Speed (Knots)			
Maritime Targets Position Accuracy with Electronic Countermeasures (Nautical Miles)			
Maritime Targets Detection Range with Electronic Countermeasures (Nautical Miles)			
Maritime Target/Land Resolution (Nautical Miles)			
Joint Tactical Information Distribution System			
Message Transfer Ratio (Percent)			
Electronic Counter-Countermeasure Margin (Decibels)†			
Net Initialization Time (Minutes)			
Net Entry Time (Minutes)			
Terminal Initialization Time (Minutes) Automatic			

* Sea states were defined as M-moderate (1-5ft), R-rough (5-8ft), VR-very rough (8-12ft), and H-high (over 12ft).
** Not obtained during Initial Operational Test and Evaluation (IOT&E) conducted 15 September to 30 October 1981.
† Mode 1 double pulse continuous full band average jammer power divided by average signal power.
†† Estimated based on manual initialization time of [ ]

4. Current Test and Evaluation (T&E):

T&E Activity (Past 12 Months)

Event	Planned Activity	Actual Date	Remarks
IOT&E	Apr 86 - May 86	Nov 86 - Dec 86	

T&E Activity (Next 12 Months)

Event	Planned Date	Remarks
DT&E	May 87 - Sep 87	Includes HAVE QUICK A-Net IOT&E objectives

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 27423F
DOD Mission Area: 345 - Tactical Communications

Title: Advanced Communication Systems
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		58,628	31,900	34,549	11,089	0	276,363
2614	Single Channel Ground and Airborne Radio System VHF (SINCGARS-V)	16,100	5,600	7,300	4,200	0	50,356
2939	Enhanced Joint Tactical Information Distribution System (EJS)	25,428	0	0	0	0	127,885
2982	HAVE QUICK II	17,100	26,300	27,249	6,889	0	98,122

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Existing Soviet capabilities in communications jamming are sufficient to severely disrupt tactical Ultra High Frequency (UHF) and Very High Frequency (VHF) communications. Extensive communications jamming, as demonstrated during the 1973 Mid-East War, is expected to limit effectiveness of UHF and VHF voice communications. The Air Force relies on UHF communications for primary tactical command and control. VHF communications are vital for interoperability/coordination between Air Force and Army forces. Disruption of any of these critical communications would significantly degrade the effectiveness of our tactical forces. The Air Force will participate with the Army to plan for integration of the SINCGARS-V anti-jam (AJ) capability into those weapon systems requiring direct communication with Army and Navy forces using SINCGARS-V. This is part of an overall requirement directed by the Joint Chiefs of Staff. EJS is a high AJ voice communications capability which was designed to meet the long-term threat. The stand-alone EJS program was cancelled in FY 1986 with EJS technology to be transferred to an advanced development project in another program element (PE 63727F). HAVE QUICK is a near-term program applying demonstrated technology and providing an urgently needed resistance to jammers while more capable systems are being developed. HAVE QUICK is the standard for jam-resistant UHF voice interoperability among U.S. forces and within NATO. HAVE QUICK II is the program to develop HAVE QUICK operational enhancements and performance improvements required to meet the evolving, increasingly sophisticated communications jamming threat. HAVE QUICK II is being introduced into NATO and a NATO Standardization Agreement (STANAG) for this effort is currently in coordination.

Program Element: 27423F
DOD Mission Area: 345 - Tactical Communications

Title: Advanced Communication Systems
Budget Activity: 4 - Tactical Programs

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
RDT&E	100,786	33,335	30,437	N/A	9,200	306,685
Aircraft Procurement	11,200	40,700	32,900	N/A	234,400	327,900
Other Procurement	13,584	29,467	15,332	N/A	60,430	124,054

EXPLANATION: (U) The FY 1986 decrease in RDT&E funding of $42.2 million reflects a Gramm-Rudman-Hollings reduction ($6.2 million) and the termination of the Enhanced JTIDS (EJS) Program ($36.0 million). The FY 1987 decrease in RDT&E funding of $1.435 million reflects a Congressional reduction ($.335 million) and a reduction due to revised inflation indices and a revised contract profit policy ($1.1 million). The FY 1988 increase in RDT&E funding is the result of two seperate actions: $1.5 million was reprogrammed from SINCGARS 3080 funds and $3.6 million additional RDT&E funding was added to SINCGARS. These increases were partially offset by a reduction in RDT&E funding for consultant support. The increase in aircraft procurement (3010) funding in FY 1987 ($1.9 million) and the decrease in FY 1988 ($23.9 million) are the result of Class V modification adjustments, including a delay in the start of HAVE QUICK IIA production until FY 1989. The decrease of $14.6 million in FY 1987 other procurement (3080) reflects a Congressional reduction. These funds were originally requested to procure ground SINCGARS radios from the Army; slips in the Army production program meant no radios were available for purchase. The reduction of $9.4 million in FY 1988 3080 funding is made up of three parts: $1.5 million was reprogrammed to the RDT&E (3600) line, $1.1 million of the reduction is the result of a Class V modification adjustment, and the remaining $6.8 million was deleted from the SINCGARS Program in an attempt to more closely align AF Airborne SINCGARS procurement with that of the Army.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Aircraft Procurement						
2614 SINCGARS-V*						
Funds					210,800	210,800
Quantities					4,787	4,787
2982 - HAVE QUICK II*						
Funds	11,200	42,600	9,000	31,156	272,109	374,765
Quantities (Kits)	1,660	6,707	125	1,619	15,598	25,709
Other Procurement						
2614 - SINCGARS-V*						
Funds					108,800	108,800
Quantities					3,587	3,587

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
2982 - HAVE QUICK II*						
Funds	13,584	14,512	5,963	7,810	65,499	113,679
Quantities (Kits)	1,013	810	594	724	2,137	5,278

* Unit prices of kits vary according to improvement(s) being provided in individual kits and according to specific radio system configuration or support equipment being modified or acquired.

5. (U) RELATED ACTIVITIES: The Air Force is participating in the Army Single Channel Ground and Airborne Radio System-VHF (SINCGARS-V) program, PE 63746A, as part of the Joint Chiefs of Staff validated Joint Operational Requirement. Requirements and technical approaches are being worked with the Navy and the Army to insure interoperability.

6. (U) WORK PERFORMED BY: Air Force Systems Command, Electronic Systems Division, Hanscom AFB, MA, has program management responsibility. Magnavox Corporation, Ft Wayne, IN, is the prime contractor for HAVE QUICK, as well as HAVE QUICK II, and HAVE QUICK IIA (development). Cincinnati Electronics Corporation, Cincinnati, OH, is the prime contractor for the Air Force airborne SINCGARS-V with McDonnell Douglas Electronics Company, St Charles, MO, as a second source. The ground SINCGARS-V contractor is ITT, Ft Wayne, IN. The major support organizations include the MITRE Corporation, Bedford, MA (all projects); Electromagnetic Compatibility Analysis Center, Annapolis, MD (all projects); and the 3246th TW, Eglin AFB, FL (all projects).

7. (U) PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) PROJECT: 2614, SINCGARS-V. The Army has development responsibility for a new family of Single Channel Ground and Airborne Radio System VHF (SINCGARS-V) radios. The SINCGARS-V Program will modernize current field VHF radios and provide an anti-jam, secure Electronic Counter-Countermeasures (ECCM) capability. The Air Force is planning to be interoperable with Army SINCGARS-V to accomplish the close air support mission. This project allows Air Force participation in the Army SINCGARS-V Program and provides the engineering development required to integrate SINCGARS-V into tactical aircraft via a form, fit, function (F^3) replacement for the AN/ARC-186 VHF Amplitude Modulated/Frequency Modulated airborne radio. This effort insures Air Force interoperability with Army, Navy, Marine Corps and any other forces that may employ SINCGARS-V. Production funding in the program is included for procurement of Air Force developed airborne radios and electronically tuned antennas as well as procurement of Army developed ground SINCGARS-V radios. In FY 1986 the program continued Full Scale Development (FSD) of the F^3 SINCGARS-V capable replacement for the ARC-186, including contractor design/fabrication/test of engineering hardware, and planning for Development Test and Evaluation/Initial Operational Test and Evaluation (DT&E/IOT&E). In FY 1987 the program will continue FSD of the airborne SINCGARS radio, including incorporation of provisions for later addition of embedded communications security (COMSEC). Planning for DT&E/IOT&E will be finalized and DT&E/IOT&E will begin. The majority of the testing (DT&E/IOT&E) effort will be

accomplished in FY 1988. As a result of a recent rephasing of the AF SINCGARS program to align it more closely with the Army's SINCGARS program, airborne SINCGARS has limited RDT&E funds to continue FSD into FY 1989. In 1989, FSD of the airborne SINCGARS radio will be completed. Procurement of the airborne SINCGARS radios as well as ground radios from the Army (via an existing Army contract) will be initiated in FY 1990.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2982, HAVE QUICK II

A. (U) Project Description: HAVE QUICK is a slow frequency hopping Ultra High Frequency radio which is providing near-term anti-jam (AJ) voice communications. HAVE QUICK II will assess HAVE QUICK vulnerabilities and develop/implement HAVE QUICK operational enhancements and performance improvements required to meet the evolving threat. Improvements include increasing the number of frequencies over which the system can hop, increasing the modulation factor, expanding time dissemination methods, increasing the number of preset frequencies, providing for multiple and automatic Word-of-Day entry (new control head) and optimizing co-site performance. Other key improvements include raising the output power (to 20 watts) and increasing the hopping rate/providing for finer frequency resolution (nicknamed HAVE QUICK IIA), providing for HAVE QUICK/Global Positioning System time interfaces and embedded communications security (COMSEC).

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Continued vulnerability analyses and studies of possible additional improvements; completed FSD of several improvements/enhancements, including Development Test and Evaluation/Initial Operational Test and Evaluation (DT&E/IOT&E) of a new control head; continued development of faster hopping/finer frequency resolution and 20 watt output power capability; continued production of expanded memory boards; and initiated studies for additional improvements--i.e., 100 watt power amplifier.

(2) (U) FY 1987 Program: Will continue: vulnerability analyses; studies of additional potential improvements; production of previously initiated improvements/enhancements including expanded memory boards. Delivery of expanded memory boards to field units for installation into HAVE QUICK radios will begin. Development of a faster hopping capability will continue and development of other improvements--e.g.,100 watt power amplifier will begin. Will also initiate development of timing interfaces between HAVE QUICK radios and Global Positioning System equipment as well as initial provisions for embedded COMSEC in HAVE QUICK. Procurement of new control heads will begin.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Will continue vulnerability analyses and production of previously initiated improvements/enhancements--e.g., new control head; and development of other improvements--i.e., 100 watt power amplifier, timing interfaces between HAVE QUICK radios and Global Positioning System equipment, and provisions for embedded COMSEC in HAVE QUICK. Will complete development of the 20 watt output power and faster frequency hopping/finer frequency resolution capability (HAVE QUICK IIA).

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Will complete development of all HAVE QUICK improvements. Will initiate procurement of the 20 watt output power and faster frequency hopping/finer frequency resolution capability (HAVE QUICK IIA). Will also begin procurement of 100 watt power amplifier and timing interfaces between HAVE QUICK radios and Global Positioning System equipment. This is the last planned year of RDT&E funding.

(5) (U) Program to Completion: Will complete production and installation of all improvements.

C. (U) Major Milestones:

Milestones		Dates
(1) (U) Program Management Directive		May 1983
(2) (U) Full Scale Development (FSD), Initial Improvements		May 1984 - May 1986
(3) (U) FSD, HAVE QUICK IIA Airborne Radio		June 1984 - February 1988
(4) (U) Production Award, Expanded Memory Board		March 1985
(5) (U) Production Award, New Control Head		December 1986
(6) (U) FSD, HAVE QUICK IIA Ground Radio		April 1987 - March 1989
(7) (U) Production Award, HAVE QUICK IIA Airborne Radio	*(1Q FY 90)	October 1988
(8) (U) Production Award, HAVE QUICK IIA Ground Radio		December 1990

* Date presented in FY 1987 Descriptive Summary

(U) Explanation of Milestone Changes

(3) (U) This is a new milestone, provided as a clarification of the development schedule for the HAVE QUICK IIA (faster frequency hopping) airborne radio.

(5) (U) This is a new milestone. The new control head was previously included within the milestone "Follow-On Improvements."

(6) (U) Start of development effort has been delayed two months.

(7) (U) Production award date for the HAVE QUICK IIA airborne radio has been advanced approximately one year.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: #27431F
DOD Mission Area: #324 - TIARA Capabilities Development

Title: Tactical Air Intelligence System (TAIS) Activities
Budget Activity: #4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	1,390	476	1,950	0	0	5,554
2904	Central Command (CENTCOM) Support	1,385	0	0	0	0	2,549
3009	Intra-Theater Intelligence Communications Network (IINCOMNET)	5	476	1,950	0	0	3,062

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The tactical forces are faced with a critical deficiency in their capability to rapidly and accurately process and disseminate intelligence information from various sources to operational commands and command and control elements. The purpose of this program is to develop, acquire, and operate land-based processing, exploitation and dissemination systems used by tactically deployed general purpose forces.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	2,135	492	491	N/A	0	4,317
Other Procurement	6,711	13,642	3,691	N/A	1,401	25,445

EXPLANATION: Reprogramming of FY 1988 funds from Other Procurement to RDT&E reflect decision to use the [ ] These funds provide software development and integration for IINCOMNET use.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
Other Procurement:						
CENTCOM						
Funds	2,161	3,739	1,500	0	0	7,400
Quantities		Not Applicable				
IINCOMNET						
Funds	4,278	9,688	691	457	944	16,058
Quantities	(6)	(22)	(4)	(0)	(0)	(32)

5. RELATED ACTIVITIES: Project 2904, Central Command (CENTCOM) Support, used the Army developed AN/TSQ-130(V) to satisfy its initial hardware requirements. PE 31335F, Air Force Automated Data Processing Support to the General Defense Intelligence Program activities is also directly applicable to this project. Project 3009, Intra-Theater Intelligence Communications Network (IIHCOMNET), developed capabilities must be compatible with and integrated in the European segment of the Defense Data Network for common-user service, PE 33126F, Long Haul Communications - Defense Communications System, as well as equipment developed under PE 28010F, Joint Tactical Communications Program. [ ] for the proposed dedicated portion of IINCOMNET. The Air Force established the Intelligence Information Systems Committee, with membership from major air command intelligence and communications and computer staffs and participation from the National Security Agency, the Defense Intelligence Agency's Intelligence Communications Architecture Project Office (INCA PO), and the Defense Communications Agency, to ensure fully coordinated intelligence communications and computer planning. Preliminary demonstration of the feasibility of the proposed dedicated portion of IINCOMNET, Project ENDRUN, is being conducted under PE 35885G, with financial support from the INCA PO, which supports IINCOMNET objectives.

6. (U) WORK PERFORMED BY: Air Force management is provided by HQ US Air Forces in Europe, Ramstein AB, GE, and Rome Air Development Center, Griffiss AFB, NY. LOGICON Operating Systems, San Diego, CA is responsible for IINCOMNET multi-level secure release software. Tobyhanna Army Depot, Tobyhanna, PA, is integrating contractor for the communications shelter developed under Project 2904, CENTCOM Support. Planning Research Corporation, McLean, VA, and RCA, Burlington, MA, are responsible for software and hardware support, respectively, for the interim automated data processing systems at CENTCOM.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3009, IINCOMNET

A. Project Description: [

] The Air Force Intelligence Information Systems Committee has identified improvements in terrestrial intelligence communications as its number one priority. This project funds the development and implementation of a high capacity multimode data distribution network through a combination of common-user packet switching capability and [ ] The packet switching capability will be compatible with and integrated into the European segment of the Defense Data Network. [ ]

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Efforts concentrated on procuring a user subsystem, software, and Defense Data Network (DDN) service. Engineering efforts were required to integrate the DDN service and minihost processors, refine protocols for the system, determine network services, design a network data base and develop interfaces to other communications systems (e.g., packet radios and NATO networks) and between processors.

(2) FY 1987 Program: The project will continue the engineering efforts begun in FY 1986 to interface to other communication systems and provide multi-level security release. Phase I communications equipment will be installed at the [redacted] This will result in an Initial Operational Capability (IOC) during the third quarter of this year.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The program will complete the major engineering efforts of the previous two years and achieve final RDT&E interface with other communication systems and processors to provide multi-level security during this year. This will result in a Final Operational Capability (FOC) for the Phase I system when the equipment is installed in the main operating bases. Phase 2 IOC will occur when the multi-level release system is implemented this year. Cost estimates are Category III, Budgetary.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: No RDT&E funds are required for this year. The Phase 2 program will reach FOC with implementation of the multi-net gateway.

(5) (U) Program to Completion: Not applicable.

C. (U) Major Milestones: Not Applicable.

8. (U) PROJECTS OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: #27435F (27431F) (64751F)
DOD Mission Area: #327 - TIARA for Tactical Air Warfare

Title: Tactical Reconnaissance Imagery and Exploitation
Budget Activity: #4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	7,015	803	1,142	1,534	0	11,882
2387	Intra-Theater Imagery Transmission System (IITS)	920	708	1,142	1,534	0	5,350
3068	Joint Service Imagery Processing System*	6,095	95	0	0	0	6,532

*FY 1987 funds will be combined with funds from PE 27217F to continue this effort in FY 1987 and following years. This project was formerly known as the Advanced Deployable Digital Imagery Support System. Details of the current efforts and follow-on objectives are in the PE 27217F Descriptive Summary.

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The tactical forces are faced with a critical deficiency in their capability to rapidly receive, process, exploit, and disseminate reconnaissance imagery from various collection systems. This program develops and acquires ground-based imagery processing, analysis, and dissemination systems for use by tactically deployed general purpose forces. In those cases where contractor estimates exist, this program is budgeted at the most likely cost and does not differ materially from known contractor estimates.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	7,495	831	99	N/A	Continuing	N/A
Other Procurement	19,960	12,349	9,717	N/A	Continuing	N/A

EXPLANATION: (U) FY 1990 RDT&E funds were reprogrammed to FY 1988 in the IITS program to support the development of modular automated test equipment. The reduction of other procurement funds in FY 1988 reflect a decision to terminate the IITS program.

Program Element: #27435F (27431F) (64751F)
DOD Mission Area: #327 - TIARA for Tactical Air Warfare

Title: Tactical Reconnaissance Imagery and Exploitation
Budget Activity: #4 - Tactical Programs

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Other Procurement:	18,980	12,349	0	0	28,480	60,817
Intra-Theater Imagery Transmission System (IITS)						
Funds	4,774	12,349	0	0	0	18,131
Quantities	(24)	(59)	(0)	(0)	(0)	(83)
Joint Service Imagery Processing System (JSIPS)						
Funds	14,206	0	0	0	28,480	42,686
Quantities	(1)	(0)	(0)	(0)	(1)	(2)

5. RELATED ACTIVITIES: The IITS program uses a Tactical Digital Facsimile (TDF) device which was initially developed for the Navy in PE 28010F (Joint Tactical Communications Program). The secondary dissemination role of IITS will provide capabilities to the following imagery related PEs 64756F (Side Looking Airborne Radar), 64750F (Intelligence Equipment) and RDT&E funds to continue work in the JSIPS program are programmed in PE 27217F (Tactical Air Reconnaissance System) for FY 1987 and will be continued in PE 64750F in FY 1988. In addition to Air Force funds, PE 64718M (All Source Imagery Processor) from the Marine Corps is providing funding to the JSIPS project. A memorandum of agreement between the Air Force and the Marine Corps has been established to consolidate development efforts of the Marine Corps All Source Imagery Processor with the JSIPS program. Efforts are underway to further incorporate the Army Imagery Processing and Dissemination System into this agreement.

6. (U) WORK PERFORMED BY: Program management for the IITS program is provided by Air Force Systems Command, Electronic Systems Division (AFSC/ESD), Hanscom AFB, MA, with assistance from the MITRE Corporation, Bedford, MA. Litton Amecom Corporation, College Park, MD, and Long Island, NY, is the contractor for production of the TDF transceiver for use in the IITS program. Program management for JSIPS is also performed by AFSC/ESD with engineering support services provided by MITRE Corporation.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2387, IITS:

A. Project Description: The IITS project is designed to provide secure transmission of high priority imagery that has already been exploited and annotated. Transmission may be over the This imagery will be transmitted to

command and control centers, mission planners and air crews. Use of these transceivers will greatly improve the delivery of time sensitive target imagery to the air crews and will relieve aircraft and crews from courier duty and conserve fuel currently used to distribute priority imagery. Timely imagery support will significantly enhance pre and post mission planning, target and ordnance selection, as well as target orientation for the air crews.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: The communication interface requirements between the Intra-Theater Imagery Transmission System (IITS) and the Defense Data Network (DDN) were defined. Additionally, the system design specifications a statement of work and a request for proposal were completed.

(2) (U) FY 1987 Program: Production of the Tactical Digital Facsimiles (TDF) will begin. The contract for the integration of TDS's with the various cryptologic, communication, and ancillary equipment into an IITS terminal will be awarded. The IITS contractor will begin production preparation procurement/development of the long-lead integration items.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Beginning in FY 1988 seven first article IITS terminals will be delivered to undergo development test and evaluation with production immediately following. The TDF's will then be integrated with the DDN interface/processors and ancillary equipment to form an IITS terminal. Cost estimates for this program are Category IV.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Development of modular automated test equipment, to support repair and trouble shooting of line replaceable units will occur in this year. Cost estimates for this program are Category IV.

(5) (U) Program to Completion: Delivery and installation of IITS terminals should be completed in FY 1989.

C. (U) Major Milestones: Not Applicable.

8. (U) PROJECTS OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 28010F Title: Joint Tactical Communications Program (TRI-TAC)
DOD Mission Area: 345 - Tactical Communications Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		4,396	6,975	15,872	8,102	Continuing	N/A
2260	Communications Nodal Control Element	2,800	1,200	1,200	0	0	153,400
2266	Digital Troposcatter Terminal	700	4,820	9,800	3,800	Continuing	64,000
2270	Support and Integration	896	955	4,872	4,302	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The TRI-TAC program develops digital communications equipment for tactical operations. The Air Force needs to replace the aging and outdated equipment now in use with a secure, anti-jam communications network. Equipment developments include transmission and switching equipment, system control facilities, local distribution equipment, terminal devices, and interface equipment. The Air Force part of this joint development includes the Digital Troposcatter Terminal (TROPO) and Communications Nodal Control Equipment (CNCE).

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	4,776	11,425	13,349	N/A	Continuing	N/A
Other Procurement	174,339	264,269	254,563	N/A	Continuing	N/A

EXPLANATION: (U) Changes in FY 1986 due to Gramm-Rudman-Hollings and in FY 1987 due to Congressional reduction. FY 1988 RDT&E funding increase due to transfer of Tactical Generic Cable Replacement program from PE 63726 and PE 27412. Changes to FY 1988/89 Other Procurement due to general program reductions. Also, production of five TTC-42 Unit Level Circuit Switches were deferred from FY 1988 to FY 1989 to reduce risk.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Other Procurement* Funds	159,704	170,396	199,282	201,537	Continuing	N/A

* These funds are for the procurement of numerous items of TRI-TAC equipment including initial spares funds and are not identified by project but applies to entire Program Element.

5. (U) RELATED ACTIVITIES: Work under Program Element 28010F is conducted by all Services under the overall direction of the Office of Assistant Secretary of Defense, Command, Control, Communications (C^3) and Intelligence, and the guidance of the Joint Tactical C^3 Agency, Ft Monmouth, NJ. Developments and interfaces of tactical communications systems are coordinated within this program element. The objective is to ensure sufficient coordination to prevent duplication of effort and to permit standardization of interfaces. The program also interfaces with the Tactical Air Control System Improvement Program, PE 27412F, through a bilateral working group and the Fiber Optics Development Program, PE 63726F, through the Air Force Fiber Optics Working Group.

6. (U) WORK PERFORMED BY: The Air Force Systems Command manages the Air Force portion of this program through the Electronic Systems Division, Hanscom AFB, MA, and Rome Air Development Center, Griffiss AFB, NY. Current contractors include: Martin-Marietta Corporation, Orlando, FL, Communications Nodal Control Element (CNCE); Raytheon Company, Sudbury, MA, Troposcatter Radio (TROPO); Analytical Systems Engineering Corporation, Burlington, MA, System Engineering Support; and MITRE Corporation, Bedford, MA, System Engineering Support.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 2260, Communications Nodal Control Element. The CNCE is the hub of the Tactical Communications System, controlling the TRI-TAC system for maximum efficiency as well as providing an interface point for allied and commercial systems. This equipment is in production with an initial delivery in August 1986. The design of depot level Peculiar Support Equipment (PSE) hardware items was completed in FY 1986. In FY 1986, the design of software for depot level automated test equipment began and will continue through FY 1987 and complete in FY 1988. Equipment to support operational software maintenance will be designed in FY 1987 and completed in FY 1988. These developments are required for organic support of the CNCE. Interim contractor support will be required until these are available.

B. (U) Project: 2266, Digital Troposcatter Terminal. The AN/TRC-170 is a digital troposcatter radio for

long-range, wideband tactical communications in support of the Tactical Air Control System and deployment of Tactical Air Forces. First production deliveries occurred in November 1984. In FY 1986, design of Peculiar Support Equipment was completed. Technical definition of the Electronic Counter-Countermeasures (ECCM) design will be completed and source selection will be held for an FY 1987 contract. The full scale development of the ECCM will begin in FY 1987 and continue through FY 1988 with fabrication and testing in FY 1989, and complete in FY 1990.

C. (U) Project: 2270, Support and Integration. This project provides for the integrated planning and system manuals required to incorporate the new digital systems into the current inventory as the various TRI-TAC equipments are fielded. Deliveries occur over several years. Also included are Air Force support equipment, manuals, and Engineering Change Proposals (ECPs) for equipment developed by other services; interface equipment; Air Force peculiar Initial Operational Test and Evaluation; and basic program office support. In FY 1986, peculiar support equipment for items purchased by other services was funded. Support for fielding AN/TRC-170 troposcatter radios continued and support began for fielding of the Communications Nodal Control Equipment, the principal equipment required for operation as a system. These integration and support efforts continue in FY 1987, 1988, 1989 and throughout the program as new systems are fielded. Funding is related to production deliveries and based on experience with equipments already delivered. Also, the full scale development of the Tactical Generic Cable Replacement Program to replace 26-pair copper cable with Fiber Optics will be complete in FY 1988 and FY 1989.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

Budget Activity: 4, Tactical Programs
Program Element: 28010F, Joint Tactical Communications (TRI-TAC)

Test and Evaluation Data

1. (U) Development Test and Evaluation (DT&E): The Joint Tactical Communications (TRI-TAC) program is a joint program with each service and the National Security Agency responsible for the development of assigned equipment, including DT&E. The Air Force has been assigned the Communications Nodal Control Element (CNCE), Digital Troposcatter Radio (AN/TRC-170), and the Digital Nonsecure Voice Terminal (DNVT). Developmental testing of these equipments has been completed. DT&E included hardware integration testing, communications security, integration, reliability and maintainability, and acceptance testing of peripheral equipment. Follow-on Operational Test and Evaluation is scheduled for early 1987. The contractor for the CNCE is Martin-Marietta, Orlando, FL. The Raytheon Co., Sudbury, MA, is the prime contractor for the AN/TRC-170. The contractor for the DNVT is General Atronics Corp, Philadelphia, PA. These equipments are presently in production.

2. (U) Operational Test and Evaluation: TRI-TAC equipment is used by the Army, Air Force and the Marine Corps for much or all of their tactical communications. The system provides point-to-point transmission gear, message circuit switches, control elements, multiplexers and terminal devices. For the Air Force, TRI-TAC equipment will be used to provide tactical communications to the Tactical Air Control System (TACS) and to the Combat Information Systems Groups (CISG). As its name suggests, the CNCE provides technical control to either the TACS or CISGs, through a series of control nodes.

(U) The CNCE has to interface with the transmission system, switches and a variety of terminals. All internodal trunking groups (point to point long-haul tranmssions) and dedicated circuits (i.e., long locals, local subscribers) will transeverse the CNCE. The CNCE will also be required to interface with all external comunications networks, including the Defense Communications System, commercial systems and other unique communications systems. The CNCE is compatable and interoperable with existing communications equipment and with other TRI-TAC gear, and will be tested with both.

(U) The Follow-On Operational Test and Evaluation (FOT&E) of the Communicaions Nodal Control Element (CNCE) is managed by the Air Force Operational Test and Evaluation Center (AFOTEC). An FOT&E test team has been formed which includes personnel from Tactical Air Command and Air Force Communications Command. All test scenarios have been structured to accommodate the test program and satisfy the operational scenarios. A 45-day test has been scheduled to fully test CNCE under operational conditions.

(U) Pertinent Operational Test Reports: AFOTEC Air Force Evaluation Report for the TRI-TAC AN/TSQ-111 CNCE dated January 1982. AFOTEC TRI-TAC AN/TRC-170 (V) Tropo IOT&E Report dated December 1980. AFOTEC report Air Force Evaluation Report for the TRI-TAC TA-954(V)1/TT. AFOTEC Air Force Evaluation Report for the TRI-TAC TA-954(V)2/TT and TA-984(V)2/TT ECI DNVT dated May 1982.

Budget Acticity: 4, Tactical Programs
Program Element: 28010F, Joint Tactical Communications (TRI-TAC)

3. (U) System Characteristics:

CHARACTERISTICS	OBJECTIVE/THRESHOLD	DEMONSTRATED
Communications Nodal Control Element:		
Digital Groups		
Type I	48	48
Type II	480	480
Analog Channels		
Type I	24	24
Type II	144	144
Transmission Rates		
Analog	4-108 HZ	4-108HZ
Digital	0-19.2 MB/s	0-19.2 MB/s
Troposcatter Radio:		
Power		
Type 1	10 Kilowatts	10 Kilowatts
Type 2	1.5 Kilowatts	1.5 Kilowatts
Type 3	.66 Kilowatts	.66 Kilowatts
Range		
Type 1	200	200
Type 2	[illegible]	150
Type 3	[illegible]	100
Capacity (Digital Channels)	60	60
Digital Nonsecure Voice Terminal:		
Range	4-8 KM	4-8 KM
Weight	6 Lbs	6 Lbs
Rate	16/32 KB/s	16/32 KB/s

Budget Activity: 4, Tactical Programs
Program Element: 28010F, Joint Tactical Communications (TRI-TAC)

4. (U) Current Test and Evaluation (T&E):

T&E Activity (Past 12 Months):

EVENT	Planned Activity	Actual Date	Remarks
None			

T&E Activity (Next 12 Months):

EVENT	Planned Activity	Remarks
Communications Nodal Control Element (CNCE) FOT&E	1st QTR FY1987	Demonstrate the CNCE's ability to control a tactical communications network, to demonstrate its availability and its logistics supportability.
TEMP Approval	Feb 87	

FY 1988/FY1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 33605F Title: Satellite Communications (SATCOM) Terminals
DOD Mission Area: 333 - Strategic Communications Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		3,949	4,461	23,783	22,760	Continuing	N/A
3163	UHF Satellite Terminal System (USTS)	3,834	3,600	3,820	0	0	13,986
3164	Ground Mobile Forces Terminals (GMFT)	115	861	2,113	2,377	Continuing	N/A
3594	Universal SHF Satellite Communications Modem	0	0*	17,850	20,383	1,900	48,633

* Approximately $8,500 to be transferred from DCA, PE 33126K.

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Ultra High Frequency (UHF) Satellite Terminal System (USTS) program, formerly the Military Airlift Command (MAC) UHF Satellite Terminal (MUST), (Project 3163) will develop a small UHF satellite communications terminal which will operate in either the airborne or ground mobile mode to support MAC and other Air Force communications requirements. These terminals will permit more effective military operations by providing Air Force users with a flexible, reliable, and secure worldwide Command and Control (C2) system using UHF satellites. The USTS terminal will also provide interoperable modes with the Navy developed UHF satellite systems. The Ground Mobile Forces Terminals (GMFT) program (Project 3164) is a program to develop a family of tactical satellite communications terminals to support tactical ground forces. The Air Force requirements in the GMFT program include development of transportable network control capability and small (man-transportable and para-droppable) Extremely High Frequency and Super High Frequency (SHF) tactical satellite terminals to meet requirements of Special Operations Forces, MAC Combat Control Teams and elements of the Tactical Air Control System. The Universal SHF Satellite Communications Modem (Project 3594) will develop an interoperable, anti-jam, nuclear-capable modem for use in all SHF terminals that use the Defense Satellite Communications System (DSCS) satellites. The modem will provide interoperability among the strategic and tactical elements of all the military services. Additionally, a Memorandum of Understanding is being negotiated to establish a joint program with the United Kingdom.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	4,814	4,615	4,464	N/A	Continuing	N/A
Other Procurement	0	0	3,820	N/A	Continuing	N/A

EXPLANATION: The Office of the Secretary of Defense transferred responsibility/funding for development of the Universal Super High Frequency modem from the Defense Communications Agency to the Air Force. Also, the Ground Mobile Forces Terminals program was descoped by $2 million in FY 1989. Finally, a reduction of $.9 million in FY 1986 RDT&E and an increase of of $1.5 million in FY 1988 RDT&E is primarily due to an initial delay in the USTS program for resolution of Joint Service requirements.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Other Procurement:						
Funds (USTS only)	0	0	0	16,732	Continuing	N/A
Quantities (USTS)	0	0	0	95		

5. (U) RELATED ACTIVITIES: Prior to FY 1985, funding for Military Airlift Command MAC) Command and Control (C2) Upgrades was programmed in PE 41840F (MAC C2 Upgrades). Beginning in FY 1985, the satellite terminal development and acquisition portion of the MAC upgrades was transferred to PE 33605F. Other portion of the MAC C2 upgrades remain in PE 41840F. In the Ground Mobile Forces Terminals program, the Army's Satellite Communications Agency (CECOM) acts as contracting agent for the Air Force terminals. Air Force Systems Command's Electronic Systems Division works with the Army to insure development of equipment that meets Air Force requirements and is interoperable with equipment developed for the Army and other Services. The Defense Communications Agency (DCA) initiated the Universal SHF modem definition under PE 33126K, and will remain responsible for overall systems integration.

6. (U) WORK PERFORMED BY: Electronic Systems Division (Air Force Systems Command), Hanscom Air Force Base, MA, provides overall program management for the projects. Currently, MITRE Corporation, Bedford, MA, is assisting Electronic Systems Division in performing studies and technology assessments. Request for Proposals for the UHF Satellite Terminal System (USTS) was released in June 1986. Under the Army Single Channel Objective Tactical Terminal (SCOTT) program, Magnavox and Raytheon as a team received a Full Scale Development contract in December 1985.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 3163, UHF Satellite Terminal System (USTS). Military Airlift Command and other Air Force users require highly mobile satellite terminals for airborne and ground applications. These terminals will be configured with Demand Assigned Multiple Access (DAMA) equipment to allow maximum efficient use of the Ultra High Frequency (UHF) satellites. Without DAMA equipment being built into the terminal, future UHF satellite capacity will not be able to

support total mission requirements. Demand Assigned Multiple Access equipment allows a dramatic increase in service to users by sharing of capacity on an as-needed basis and then only for the time actually required to pass information. FY 1986 funds supported formulation of equipment and system specifications and preparation of the Request for Proposals. FY 1987 and FY 1988 fund development of the equipment with completion in FY 1988.

B. (U) Project: 3164, Ground Mobile Forces Terminals (GMFT). The Air Force requires a small, lightweight satellite communications terminal to provide survivable, secure voice and data for highly mobile combat teams such as Forward Air Controllers, Special Operations Forces, and Military Airlift Command (MAC) Combat Control Teams. This project develops lightweight satellite ground terminals which can be transported by a team of personnel or be para-dropped with the team. The terminals will use the Extremely High Frequency (EHF) and Super High Frequency (SHF) technology developed under the Army programs, such as the Single Channel Objective Tactical Terminal (SCOTT) and Ground Mobile Forces Satellite Communications program. The FY 1986 program funded further study of requirements. FY 1987, FY 1988, and FY 1989 fund the formulation of man-pack satellite terminal standards and evaluation of communications protocols for operating and controlling satellite networks.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3594, Universal SHF Satellite Communications Modem

A. (U) Project Description: See paragraph 2. Develop and acquire modems for use in all U.S. SHF terminals as well as those of selected allies. The modem will provide congressionally-mandated interoperability and support all data rate communications in a hostile, electromagnetic environment. The Assistant Secretary of Defense for Command, Control, Communications and Intelligence designated this a high priority and urgent program requiring accelerated development.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: The Defense Communications Agency (DCA) and Air Force Systems Command (AFSC) have worked together on waveform definition, technical specifications, contract statement of work, request for proposals and a Memorandum of Understanding (MOU) with the United Kingdom. The efforts resulted in an orderly transfer of the program from DCA to the Air Force.

(2) (U) FY 1987 Program: A Request for Proposals (RFP) will be released, a source selection performed and contracts awarded for development of the modem. Negotiations will be completed and an MOU signed between the U.S. and United Kingdom, establishing a joint program and United Kingdom funding arrangements. The acquisition strategy has several competing Leader/Follower teams with downselection near the end of Full Scale Development.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Full Scale Development of the modem will continue. A critical design review will be conducted, followed by downselection to a single Leader/Follower

team. Concurrently, a Preplanned Product Improvement effort will be conducted to ultimately provide more throughput/channelization, a greater range of data rates and control, increased reliability and decreased size. The Category IV, planning cost, estimates were developed by the Defense Communications Agency's program office.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Full Scale Development will near completion, including most of the logistics aspects such as spares planning and training. Development tests will be conducted and most of development of the Preplanned Product Improvements will be completed. An early operational capability will be attained. The cost category is still IV, planning.

(5) (U) Program to Completion: Full Scale Development will conclude in FY 1990 with development/operational testing. Satisfactory results will lead to initiation of production, pending funding availability. Each Service will provide procurement funds for its own requirements.

C. (U) Major Milestones:

Milestones	Dates
(1) (U) Establish Air Force Program	Jul 1986
(2) (U) Release Development Request For Proposal	Dec 1986
(3) (U) Award Fixed Price Development Contract	May 1987
(4) (U) Conduct Preliminary Design Review	Jul 1987
(5) (U) Conduct Critical Design Review	Nov 1987
(6) (U) Functional/Physical Configuration Audits	1989
(7) (U) Development/Operational Testing	1990
(8) (U) Initiate Production	1990

9. (U) COOPERATIVE AGREEMENTS: This effort is planned as a codevelopment effort with the United Kingdom's Ministry of Defence. A Memorandum of Understanding is in work with the UK detailing arrangements. Current plans are for the UK to provide a proportional share of the development costs and for teaming of US and UK contractors.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 35887F
DOD Mission Area: 374 - C3 Protection/Multimission, Technology & Support

Title: Electronic Combat Intelligence Support
Budget Activity: 4 - Tactical Programs

1. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	1,464	1,691	1,622	1,682	Continuing	N/A
2907	Electronic Combat Intelligence Support	1,464	1,691	1,622	1,682	Continuing	N/A

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Electronic Combat Intelligence Support RDT&E funds support the development of Electronic Warfare Intelligence Support (EWIS) data files and the Threat Simulator Validation (SIMVAL) program. These are high priority USAF projects supporting Air Force Electronic Combat programs.

Threat simulators are employed in electronic combat equipment testing, tactics development, and aircrew training. Without this program, electronic combat equipment testing, tactics development, and aircrew training would be severely degraded.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	1,552	1,784	1,673	N/A	Continuing	N/A
Other Procurement	178	182	192	N/A	Continuing	N/A

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

Other Procurement:						
Funds	170	182	192	208	Continuing	N/A
Quantities	Not Applicable					

5. RELATED ACTIVITIES: This program supports Air Force Electronic Combat (EC) programs, especially program elements 64738F/64739F. The EWIS project provides intelligence information to self-protection EW equipment developers and other EC systems under development.

Program Element: 35887F | Title: Electronic Combat Intelligence Support
DOD Mission Area: 373 - C3 Protection/Multimission, Technology & Support | Budget Activity: 4 - Tactical Programs

6. (U) WORK PERFORMED BY: The Foreign Technology Division (FTD) at Wright-Patterson AFB, Ohio, performs Electronic Warfare Intelligence Support (EWIS) project tasks, using in-house and contract resources. Current EWIS data file development is being accomplished by the Planning Research Corporation (PRC) field office at Dayton, Ohio. The FTD also does Threat Simulator Validation (SIMVAL) program tasks for new threat simulators under development. This work is assisted by Applications Research Corporation (ARC) radar engineers in Dayton, Ohio.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2907, Electronic Combat Intelligence Support

A. Project Description: The USAF has a heavy investment in reprogrammable threat warning and jamming equipment to detect, display and disrupt enemy electronic emitters. This equipment is found in the majority of Air Force aircraft including Electronic Combat (EC) systems such as the F-4G (WILD WEASEL) and the EF-111A.

FTD produces Intelligence Data Input Packages to provide information based on the most current intelligence to designers in the form and engineering detail needed to allow systems acquisition decisions. Threat simulators are used in joint service exercises (e.g., RED FLAG and TEAM SPIRIT) and development/operational test and evaluation efforts. Additionally, the Air Force Electronic Warfare Environment Simulator (AFEWES) uses computerized threat simulations for the test and evaluation of EC equipment.

B. (U) Program Accomplishments and Future Efforts:

(1) FY 1986 Accomplishments:

FTD published baseline data to support the OSD sponsored HAVE COPPER simulator program. Some of the FTD completed reports include support to these Air Force simulator projects: MSQ-T13; MPS-T2; MPQ-T3A; AN/MSR-T4; and the Enhanced Surface-to-Air Missile Simulator (ESAMS) digital simulations.

(2) FY 1987 Program:

More work will be done on automating Intelligence Data Input Package (IDIP) production and ensuring data base interoperability with existing intelligence information files. The EWIS project will make sure FTD data bases supporting electronic warfare (EW) equipment development contain interoperable data structures that serve the intelligence information needs of EW equipment program managers. Validation efforts will continue on the OSD HAVE COPPER project and begin on support to the HAVE IRON simulator. SIMVAL reports will be provided to the AFEWES TWS-11M/TWS-10 upgrade, the SADS VIM/SADS XII, and the Modular Advanced Threat Simulator.

Program Element: 35887F
DOD Mission Area: 373 - C3 Protection/Multimission, Technology & Support

Title: Electronic Combat Intelligence Support
Budget Activity: 4 - Tactical Programs

(3) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The Electronic Warfare Intelligence Support (EWIS) and the Threat Simulator Validation (SIMVAL) will continue to support Electronic Combat (EC) programs. The EWIS and SIMVAL projects will continue to provide intelligence information to Air Force Electronic Combat programs in the detail and form demanded by development engineers.

The EWIS project will continue investigating methods to validate digital simulations and produce threat models to support selected EW equipment acquisition programs. SIMVAL will continue validation testing initiated in FY 1987.

(4) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The EWIS project will provide Intelligence Data Input Packages to simulator builders and the SIMVAL project will continue support to threat simulator development.

Additionally, the EWIS project will respond to special intelligence data information requirements of selected EW equipment developers based upon their validated operational requirements. Cost estimates fall into Category IV, Planning. Level of effort is dependent on established EC intelligence support requirements.

(5) (U) Program to Completion: Future validation efforts will be based on operational requirements for intelligence updates, and system modifications. EWIS data sub-files will be developed and maintained to support user requirements. Work will begin to define communication system interface requirements to enhance user access to the EWIS data base. This is a continuing program.

C. (U) Major Milestones: Not Applicable

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 41840F
DOD Mission Area: 356 Mobility

Title: Military Airlift Command (MAC) Command & Control System
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		10,561	10,534	10,002	11,015	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: There is a significant airlift shortfall in support of all major operations plans. In order for the Military Airlift Command (MAC) to make optimum use of its scarce airlift resources, it must rapidly exchange vital command and control (C^2) information between ground elements and airlift aircraft on a global basis. MAC's present capability, based on 1960's equipment, is seriously inadequate. MAC's command and control components must be upgraded into a coordinated, integrated system as detailed in the MAC C^2 Architecture Implementation Plan, written in June 1982. This program addresses three elements of that architecture by upgrading MAC's command centers, developing and procuring information processing support equipment, and developing a survivable, secure communications capability for all MAC echelons.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	7,741	22,712	16,139	N/A	Continuing	N/A
Other Procurement	0	4,080	27,636	N/A	Continuing	N/A

EXPLANATION:

RDT&E (U) FY 1986 reflects reprogramming for the Global Decision Support System (GDSS) less reductions for Gramm-Rudman and inflation adjustments. FY 1987 reflects Congressional reduction. The FY 1988 reduction reflects budget constraints and a decision by the Air Force to transfer funds to a higher priority program.

Procurement (U) The FY 1987 and FY 1988 decreases are due to Congressional funding cuts.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Aircraft Procurement*						
Funds	0	0	0	24,785	Continuing	N/A
Quantities	Not Applicable					
Other Procurement**						
Funds	0	3,408	15,299	28,620	Continuing	N/A
Quantities	Not Applicable					

* Aircraft procurement funds were in Program Elements 41115F, 41118F and 41119F prior to the FY 1987 President's Budget.

** Only that portion of the total procurement funding in PE 41840F dedicated to the MAC Command and Control (C^2) system upgrade is shown above.

5. (U) RELATED ACTIVITIES: RDT&E funding for Ultra High Frequency (UHF) satellite terminals is in PE 33605F, Satellite Communications Terminals.

6. (U) WORK PERFORMED BY: Air Force Systems Command's Electronic Systems Division (ESD), Hanscom AFB, MA, will provide overall program management. Jet Propulsion Laboratory, Pasadena, CA is designing the Information Processing System (IPS) testbed at McChord AFB, WA, and the Global Decision Support System (GDSS). Rockwell-Collins, Cedar Rapids, IA, is developing the Automatic Communications Processor (ACP). Other contractors have not yet been identified.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 41840F, MAC Command and Control (C^2) System

A. (U) Project Description: This project consists of three development programs to satisfy three essential elements of the MAC C^2 architecture validated in MAC Statement of Need 3-81. It develops and procures basic communications and information processing hardware and software for all echelons of the MAC C^2 system. The IPS will integrate new computer resources and software with improved High Frequency (HF) and new Ultra High Frequency (UHF) satellite networks and other communications media into a unified MAC Command and Control System. A portion of IPS is being accelerated and combined with procurement of other command post equipment to provide an immediate capability, the

Global Decision Support System (GDSS). The GDSS was initiated as an unprogrammed, fast implementation task in response to a Joint Chiefs of Staff (JCS), Chief of Staff of the Air Force, Commander-in-Chief, Military Airlift Command (MAC) Memorandum of Understanding. The Automatic Communications Processor (ACP), formerly part of the Adaptive High Frequency (HF) program, provides major improvements in HF radio communications through the development of the ACP. Features of the ACP will include anti-jam and address protection features as well as a new radio control head to improve performance of the conventional airborne radio (AN/ARC-190).

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: The combined wing-level Information Processing System (IPS) testbed continues to serve as a proof-of-concept facility, and was used to refine MAC C^2 requirements and the technical approaches to satisfy them. The draft IPS Request for Proposal (RFP) was completed. In the ACP program, design and fabrication of the control head module was completed. It will fit into the space and use the same wiring as the current Air Force HF airborne radio control head. The Class II prototype modification was completed. The GDSS hardware and initial software were installed.

(2) (U) FY 1987 Program: The FY 1987 effort is significantly increased from FY 1986 as three major development efforts progress. The IPS specification and contractual documentation, evaluation of proposals, source selection, contract award and concept definition design work will all be completed. This phase of the IPS work will initiate the evolutionary acquisition process for this global C^2 system that will continue through FY 1993. The GDSS, initiated in FY 1985 and continued through FY 1986 with Air Force reprogramming, will be completed with FY 1987 funding, complying with the two year time frame requested in the implementing Memorandum of Understanding. Software development will be completed and tested and all hardware and software made fully operational by September 1987. Full scale engineering development of the control head for the ACP will be completed, and Development Test and Evaluation (DT&E) and Initial Operational Test and Evaluation (IOT&E) of the ACP conducted, leading to an initial production decision (option) on 200 units early in FY 1988. Completion of ACP development is key to a comprehensive MAC aircraft modification program to incorporate the ACP in all airlift aircraft beginning in FY 1988.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The IPS will begin the first year of major software development and initial hardware procurement. FY 1988 funds will procure the government furnished equipment to support the IPS development, with the contract design effort continuing through critical design review and software coding. The ACP program will exercise the first production option for 200 units supporting ground and airborne applications. The aircraft ACP modification program will be initiated for C-130, C-141, and C-5 aircraft. The ACP cost estimate is category II based on sole source. The IPS cost estimate is category III, budgetary, based on contractor and program office estimates of September 1985. The GDSS is a category I, comprehensive, estimate based on sole source/existing contracts effective July 1985.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The Automatic Communications Processor (ACP) will continue production and installation in ground and airborne applications. The Information Processing System (IPS) will continue software development and coding (evolutionary) and the first units of IPS prime mission equipment will be acquired and installed. The ACP cost estimate is category II based on a sole source contract. The IPS cost estimate is category III, budgetary, based on contractor and program office estimates of September 1985.

(5) (U) Program to Completion: This is a continuing program. The IPS will continue development and implementation. The IPS will be an evolutionary capability which, when the prototype system is initially fielded, will be analysed, tested and enhanced to meet future requirements and to optimize its utility to MAC. The ACP will continue production and installation in ground and airborne applications.

C. (U) Major Milestones:

Milestones		Dates
(1) (U) Tactical Data System Development Request For Proposal (RFP) Release	*(3rd Quarter FY 1986)	Cancelled
(2) (U) Global Decision Support System (GDSS) Initial Operational Capability (IOC)		4th Quarter FY 1986
(3) (U) IPS Final Request For Proposal (RFP) Release	*(4th Quarter FY 1986)	2nd Quarter FY 1987
(4) (U) Start ACP Developmental Testing		2nd Quarter FY 1987
(5) (U) Start ACP Operational Testing		4th Quarter FY 1987
(6) (U) Award IPS Integration Contract		1st Quarter FY 1988
(7) (U) ACP Production Option		2nd Quarter FY 1988
(8) (U) ACP Production Contract		3rd Quarter FY 1989

* Date presented in FY 1987 Descriptive Summary

(U) Explanation of Milestone Changes

(1) (U) Tactical Data System development program cancelled due to Congressional budget cuts in this Program Element.

(3) (U) Four month slip due to rework on specification to incorporate integration of related MAC automated data processing upgrades.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: #44011F
DOD Mission Area: #207 - Special Operations Forces

Title: Special Operations Forces (SOF)
Budget Activity: #4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		8,531	70,579	109,487	113,461	230,203	532,261
3129	MC-130H	8,131	18,266	8,000	0	0	34,397
3173	Gunship Study	400	0	0	0	0	400
3174	SOF Sensor Upgrade	0	1,900*	2,255	0	0	4,155
3284	SOF Defensive Systems	0	5,000*	24,180	35,370	160,503	225,053
3326	AC-130U	0	45,413	67,352	47,341	6,200	166,306
3642	AC/MC-130 Training System	0	0	7,700	30,750	63,500	101,950

* Reflects FY87 Supplemental Request

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Funds worldwide Special Operations Forces (SOF) active force structure (five squadrons - three CONUS, two overseas). Current weapon systems include (primary aircraft authorized) 9 AC-130H, 11 MC-130E and 8 MH-53H aircraft. Aircraft are specially configured to perform long-range troop insertions, extractions, close air support/interdiction, psychological operations and other special functions in support of a full range of military operations. The force is specially tailored and trained for low intensity warfare, [ ] and crisis action and is able to respond to unified command tasking at all levels of conflict. The MC-130 Combat Talon is the only aircraft capable of night, adverse weather, long-range terrain following/terrain avoidance infiltration, exfiltration and resupply missions in [ ] The MC-130 is also employed as a deep penetration tanker to refuel vertical lift assets in appropriate combat areas. A 1986 joint Air Force/Army analysis of worldwide SOF airlift requirements to meet the needs of the unified commanders-in-chief as well as the Joint Special Operations Command concluded that the minimum worldwide operational requirement for MC-130s was [ ] of which [ ] are needed in MC-130H configuration and [ ] in MC-130E Tanker configuration. The results of this study formed the basis for the 1 April 1986 Secretary of Defense SOF Airlift Report submitted to Congress. This study and the Secretary's report also identified the need for [ ] AC-130 Gunships. Subsequently the Defense Resource Board (DRB) directed a joint study by the Joint Special Operations Agency (JSOA) and the Office of the Assistant Secretary of Defense for International Security Affairs with Service coordination to review alternative programs to meet Special Operations Forces (SOF) airlift requirements. This review concluded that 14 MC-130E Tanker aircraft could be counted against both the tanker and the Combat Talon (MC-130H) requirement and therefore the number of new MC-130H aircraft required would be reduced

Program Element: #44011F   Title: Special Operations Forces (SOF)
DOD Mission Area: #207- Special Operations Forces   Budget Activity: #4 - Tactical Programs

to This review also determined that retaining all AC-130 Gunships in the active component would reduce the number The 10 AC-130A Air Force Reserve (AFRES) aircraft will be retired incrementally as the new AC-130U aircraft become operational in the FY 92 time period. These old AC-130A Gunships (over 30 years old) are increasingly difficult to support due to the age of both the airframe and the special gunship mission equipment. Lack of comparability in the armament and mission equipment between these AFRES AC-130As and the active component's AC-130Hs has This program element contains RDT&E and procurement funding required to procure 24 MC-130H Combat Talon II aircraft and 12 AC-130U Gunships.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
RDT&E	9,745	66,539	68,373	N/A	180,130	334,787
Aircraft Procurement	130,800	263,000	538,800	N/A	498,100	1,650,513

(U) EXPLANATION: RDT&E: FY 1986 included an expected reprogramming request for $10 million for project 3129, MC-130H. This request was not submitted due to Congressional restrictions which delayed the release of FY 1986 funding causing an inability to obligate funds. FY 1987 was initially reduced by nonprejudicial Congressional action, and subsequently increased by the FY 1987 Supplemental Request which adds funds for the planned SECDEF SOF airlift force. This supplemental includes funds to begin the SOF defensive systems development (Project: 3284). FY 1988 increase reflects the funds needed for the SECDEF SOF airlift force. This continues the SOF Defensive Systems development, realigns the AC-130U prototype funding, and starts the AC/MC-130 Training System development (Project: 3642). Procurement: FY 1986 change is due to project 3129's, MC-130H, share of the OSD reduction distribution, the Gramm-Rudman reduction, a below-threshold reprogramming, and a reduction in the buy quantity to one (vice two) aircraft caused by the inability to obtain Congressional approval of DOD requested reprogramming. FY 1987, 88, 89, and total estimated cost increases are due to SECDEF direction to accelerate and increase the buy quantity of Project: 3129, MC-130H, a reestimation which reduced the procurement cost for Project: 3326, AC-130U, and the addition of funding required by the planned SECDEF SOF airlift force. This SECDEF force increases the FY 1987 and FY 1988 MC-130H buy quantities to seven each year and includes FY 1987 Supplemental Request funding.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

Aircraft Procurement (Project: 3129, MC-130H)						
Funds	67,478	300,377*	372,300	208,000	0	1,166,709
Quantities	1	7	7	4		

* Reflects FY87 Supplemental Request

Program Element: #44011F Title: Special Operations Forces (SOF)
DOD Mission Area: #207 - Special Operations Forces Budget Activity: #4 - Tactical Programs

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Aircraft Procurement (Project: 3326, AC-130U)						
Funds	0	18,200*	277,000	245,200	0	540,400
Quantities	0	0	5	6	0	11**
* Reflects FY87 Supplemental Request						
** 12th aircraft is the prototype aircraft (RDT&E funded)						
Military Construction (Project: 3129, MC-130H)						
Funds	6,170	0	4,000	2,450	11,441	24,061
Military Construction (Project: 3326, AC-130U)						
Funds	0	0	0	0	10,100	10,100
Military Construction (Project: 3642, AC/MC-130 Training System)						
Funds	0	0	0	4,600	0	4,600

5. (U) RELATED ACTIVITIES: The MC-130H Combat Talon II derives its basic avionics architecture from Program Element 64753F, Combat Helicopter Modernization Program (HH-60A) R&D program, which the Air Force has now cancelled. Common systems include software, displays, keyboard entry units, display electronics units, remote terminal units and forward looking infrared. With the cancellation of the HH-60A program, the development, acquisition and support costs for the MC-130H program increased. Systems development previously programmed under the HH-60A program, but required also for the MC-130H, are now programmed under the MC-130H program. FY 1986 reprogramming was requested to offset the impact of the cancellation but Congress rejected the reprogramming source on two separate occasions. The FY 1987 Supplemental Request will correct part of the procurement problem but further adjustments may be required to support the third Combat Talon II beddown location and to provide additional FY 1987 RDT&E funds in the areas of test and peculiar support equipment development.

6. (U) WORK PERFORMED BY: The MC-130H Combat Talon II program is managed by the Special Operations Forces System Program Office, Aeronautical Systems Division, Wright-Patterson AFB, OH. C-130 airframes are procured from Lockheed Corporation, Marietta, GA. IBM Federal Systems Division, Owego, NY, is the avionics systems integrator. The AC-130 is also managed by the Special Operations Forces Systems Program Office. The source for the AC-130 airframe will be Lockheed Corporation; source selection is now underway to select the avionics and weapon systems integrator. Project #3284, SOF Defensive Systems, and #3642, AC/MC-130 Training System, will also be managed by the Special Operations Forces Systems Program Office.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 3129, MC-130H. This project provides for development of intermediate and depot-level peculiar support equipment (PSE) for those avionics systems previously common between the MC-130H and the HH-60A program, and develops an integrated electronic warfare suite for the Combat Talon II. Interim contractor support is programmed to support MC-130H intermediate and depot-level support requirements during flight testing pending development and procurement of the required PSE. The program started in FY 1986 but was delayed by late congressional release of FY 1986 funding. The FY 1987 program will continue development of intermediate and depot-level avionics PSE and start development of an integrated electronic warfare suite for the Combat Talon II. The integrated electronic warfare suite is required to enable the weapon system to survive and complete its missions in an increasingly sophisticated enemy threat. In FY 1988 development of intermediate and depot-level avionics PSE and integrated electronic warfare suite for the Combat Talon weapon system will be completed. Related technical data will be developed and PSE will be tested and evaluated. FY 1989 RDT&E funding requirements, if any, will be assessed once the FY 1986 PSE development program is on contract and a proposal has been received to implement the integrated electronic warfare suite modification effort.

B. (U) Project: 3174, SOF Sensor Upgrade. This project provides for development of improved sensors and related munitions for special operations gunship (AC-130) applications. Visual sensors (low-light-level television and infrared) and electronic sensors require improvement to maintain the capability to support current tasking. A new laser target illumination system will be developed to meet the current operational need for precise target identification and greater weapons accuracy. This project is an FY 1987 new start and will concentrate on munitions development for use with the AC-130 visual and electronic sensors as well as sensor development. The FY 1988 funds will continue development of the improved sensor systems and related munitions and provide for their test and evaluation. This program is in response to an identified combat deficiency (identified during Grenada) which prevented the Gunship from striking armored targets with munitions detectable by the aircraft sensors.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3284, SOF Defensive Systems.

A. (U) Project Description: This program provides funds for requirements definition, development, test, and evaluation of an interactive electronic warfare architecture, equipment, and an integrated maintenance support system. The results of this program will identify candidate hardware for each SOF aircraft that will reduce vulnerability, detectability, and threat engagement by increasing the overall survivability of Air Force SOF assets. The initial efforts will focus on determining aircraft defensive requirements in 1986 and 1996 based on representative mission profiles and threat environments. Once requirements are defined, development of an interactive defensive system with a common architecture and essentially common components will occur for the SOF fleet: AC-130H, AC-130U, MC-130E, MC-130H, MH-53J, MH-60G, HC-130P/N, C-141B Special Operations Low Level (SOLL) II, C-130E SOLL II, and CV-22A. The interactive defensive system concept will combine information from sensors with stored information covering terrain, mission route, threat location and threat capability. It will incorporate existing and modified electronic, infrared, missile, and expendable countermeasures equipment into an interactive suite that will use stored terrain, route and threat data to

provide precise threat information to the crew. Additionally, the appropriate on-board threat countering systems and receivers will communicate among themselves in order to perform more accurately and timely while in a threat environment. This type of information will include far more precise details than are available from current non-integrated or non-interactive systems. The crew will receive instant warnings and advice on the need to counter and/or avoid a specific threat and alternative measures that could be employed. This project will also provide for later development of passive terrain following and terrain avoidance systems for Combat Talons and Gunships to reduce detection, enhance munitions, and improve high-speed airdrop systems to reduce vulnerability. Finally, an integrated maintenance concept support plan for the interactive defensive suite will be provided. This plan will be tailored to the SOF mission requirements and will consider factors such as mission readiness, deployment limitations, software reprogramming, spares and support pipelines, and organic depot capabilities and requirements.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Not Applicable.

(2) (U) FY 1987 Program: The FY 1987 funds will provide the initial modeling of mission threats using representative mission profiles to define aircraft requirements. This assessment will provide recommended candidate subsystems that will drive the development of the interactive architecture necessary to optimize the characteristics of a core ECM suite. An integrated maintenance support concept will be defined to increase commonality and reduce costs.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: FY 1988 funds will begin the SOF common integrated survivability system development. The scope and costs for incorporating this system into the MC-130H are being defined under the current MC-130H procurement program.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The FY 1989 effort will initiate similar programs to incorporate and test the SOF common system on the AC-130U and the CV-22 aircraft. Emphasis will be placed on developing a passive threat avoidance system to meet the 1996 anticipated threats.

(5) (U) Program to Completion: FY 1989 and beyond RDT&E funds will provide for completion of the development and test of prototype interactive defensive avionics suites for each SOF aircraft. Initial flight test and evaluation for the MC-130H will begin in FY 1991 with modifications starting in FY 1990. Flight test on the AC-130U will be concurrent with the MC-130H. Flight test and modification on the other SOF assets will begin in FY 1992.

Program Element: #44011F
DOD Mission Area: #207 - Special Operations Forces

Title: Special Operations Forces (SOF)
Budget Activity: #4 - Tactical Programs

C. (U) Major Milestones:

Milestones	Dates
(1) (U) Core ECM Requirements Defined	April 1987
(2) (U) RFP for Prototype Development Released	November 1987
(3) (U) Source Selection Complete, Contract Award	April 1988
(4) (U) MC-130H Prototype Flight Test Complete	November 1991
(5) (U) First USAF Delivery (MC-130H)	January 1992

9. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3326, AC-130U.

A. Project Description: This program funds procurement of 12 (10 primary aircraft authorized, 2 back-up aircraft inventory) C-130s and converts these aircraft to the side-firing gunship configuration. These new aircraft will be assigned to the 16th Special Operations Squadron (SOS), Military Airlift Command (MAC).

The new AC-130U aircraft will have an enhanced capability, improved reliability and maintainability, more survivability than the existing AC-130H aircraft and be more deployable than the older AC-130A gunships. The new aircraft subsystems will include precision navigation, target acquisition radar, fire control computers integrated on the 1553B databuss, electronic countermeasurse, infrared countermeasures, aerial refueling, covert lighting, trainable weapons, and secure communications systems. These subsytems will provide the Gunship the capability to strike targets with surgical accuracy to loiter safely in the target area for extended time periods, and to perform these tasks in night adverse weather conditions. Where practical, every effort will be made to adapt off-the-shelf equipment, and to the maximum extent, these subsystems will be common with systems on other Air Force SOF aircraft.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Not applicable.

(2) (U) FY 1987 Program: This program is an FY 1987 new start and provides funding for the prototype AC-130U. The intent of the program is to develop the unique gunship systems, integrate these systems, and develop the required peculiar support equipment. The effort necessary to integrate the weapons, the sensors, and the avionics system is substantial and comprises the majority of the prototype effort. The systems integration is essential for the gunship to fulfill its operational mission of rapid and accurate target acquisition, identification and selective target destruction. The AC-130U Request for Proposal was released to industry in December 1986 and the program has now begun source selection for the avionics/weapons integration contract. Contract award is anticipated in May 1987.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Development of the prototype AC-130U gunship will continue and development of PSE and related technical data will begin. Design efforts, laboratory and integration facility testing and concept proofing will continue. The FY 1988 effort will continue software development and integration design for the avionics, target acquisition, and ordnance ballistics computers to allow production and test of the prototype gunship. Cost estimates were based on information developed from a cost comparison analysis of similar systems under development and costs for AC-130H and MC-130E modifications, and the MC-130H development and procurement program. In an effort to control AC-130U procurement and RDT&E costs, the Air Force has directed a design to cost approach for this program and it is now in source selection on that basis. The AC-130U Request for Proposal is based on purchasing the C-130 airframe under the Air Force three year option contract from Lockheed Georgia and a competitive contract for the mission avionics, fire control and weapon systems integration.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The FY 89 request will focus on three major development areas. First, following critical design review, the integration of the low-light-level TV and the target acquisition radar will be completed. This effort comprises 34% of the Gunship's 89 RDT&E effort. Second, development and refinement (40% of the FY 89 effort) of the prototype aircraft will continue. Third, the remaining 26% of the effort will be directed at developing peculiar support equipment (PSE). Emphasis will be placed on defining and developing the required PSE for the intermediate and depot support levels. The bulk of the effort will concentrate on low-light-level TV, radar, and fire control support (includes peculiar weapons requirements) items. Flight testing of the prototype will begin in FY 89 and continue through FY 90, and the training and data development will be completed in FY 89.

(5) (U) Program to Completion: FY 1989 RDT&E funds will provide for completion of the development of the prototype aircraft with flight test and evaluation beginning in early FY 1990. Upon completion of testing in FY 1990, the AC-130U RDT&E will be complete.

C. (U) Major Milestones:

		Milestones		Dates
(1)	(U)	Request for Information (RFI) Released (Gunship Program)		November 1985
(2)	(U)	Analysis of Industry's Response to RFI Completed		January 1986
(3)	(U)	Release RFP for Prototype Development and Acquisition Options	*(March 1986)	November 1986
(4)	(U)	Source Selection Complete, Contract Award	*(January 1987)	May 1987
(5)	(U)	Support Equipment Recommendation Data Items Submitted		June 1988
(6)	(U)	Start Prototype Flight Testing		October 1989
(7)	(U)	Completion of Prototype Flight Testing		August 1990
(8)	(U)	First USAF Delivery		September 1990
(9)	(U)	Full Operational Capability (12 aircraft)		September 1993

*Date presented in FY 1987 Descriptive Summary.

Program Element: #44011F   Title: Special Operations Forces (SOF)
DOD Mission Area: #207 - Special Operations Forces   Budget Activity: #4 - Tactical Programs

(U) Explanation of Milestone Changes:

(3) (U) RFP release slipped 180 days to permit modification of RFP in light of industry comments and to adjust to changes in HQ USAF direction to incorporate a design to cost approach.

(4) (U) Contract award slipped 90 days due to slip in RFP release date.

10. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project 3642, AC/MC-130 Training System.

A. (U) Project Description: This program will develop an integrated, state-of-the-art SOF fixed-wing ground based aircrew training system (ATS) to support MC-130, Combat Talon, and AC-130, Gunship, formal training schools, annual simulator requirements, and combat mission rehearsal requirements. This requirement is driven by existing training restrictions caused by airspace limitations, weather restrictions, and mission safety considerations that dictate rehearsing certain tasks in a ground based device prior to actual mission execution. The proposed solution is to acquire a SOF fixed-wing family of training devices, curriculum, courseware, scheduling, maintenance and instruction for all crewmembers of each aircraft. The system will provide a proficiency based mix of academics, simulator training, and aircraft flight training to produce a combat qualified crewmember. Generic cockpit(s), will be utilized with separate computer programs for each aircraft. Data presented will include precise navigation integrated with an infrared detection system, multimode radar information, and aircraft performance information coupled with anti-aircraft artillery, airborne interception, defensive radar and surface-to-air missile threats.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Not applicable.

(2) (U) FY 1987 Program: No activity planned.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: This program will be an FY 1988 new start The project provides funding for the initial prototype development of a training system for the MC-130 and AC-130 gunship.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Continues development of a training system and initiates a procurement program for total contractor training support.

Program Element: #44011F Title: Special Operations Forces (SOF)
DOD Mission Area: #207 - Special Operations Forces Budget Activity: #4 - Tactical Programs

C. (U) Major Milestones:

Milestones	Dates
(1) (U) Release Request for Proposal	March 1988
(2) (U) Contract Award	September 1988
(3) (U) AC/MC-130 Course Readiness Review	June 1992
(4) (U) System Validation Complete	March 1993

II. (U) Cooperative Agreements: Not applicable.

Budget Activity: 1, Combat Aircraft
Program Element: 44011F, MC-130H

Test and Evaluation Data

1. (U) Development Test and Evaluation (DT&E): The MC-130H Combat Talon acquisition is a follow-on to the MC-130E. No DT&E is accomplished under this Program Element.

2. (U) Operation Test and Evaluation (OT&E):

(U) Previous Related Testing. Under the Credible Sport II program, an operational utility evaluation (OUE) was conducted (June through September 1982) by the 8th Special Operations Squadron, 1st Special Operations Wing, Hurlburt Field, Florida. The Credible Sport test aircraft was a residual asset of an earlier program unrelated to the Combat Talon II (CT-II) acquisition that incorporated many subsystems technologies and concepts now planned for CT-II. These included integrated, self-contained navigation/precision approach avionics, aerodynamic short takeoff and landing (STOL) features, and advanced cockpit displays. IBM was the integrating contractor. Major deficiencies were found during this test. They included inadequate inertial navigation system accuracy, insufficient display and simultaneous operations capability of the central avionics computer, immature software which adversely affected aircrew workload and provided insufficent failure warnings, and very low reliability.

(U) Qualification Operational test and Evaluation (QOT&E). A combined OT&E/QOT&E will be conducted on the first four CT-II aircraft. The first three production aircraft will be used for flight testing and the forth aircraft for technical order verification. Headquarters Military Airlift Command will conduct the QOT&E beginning in late FY 1987. The major purpose of this QOT&E is to assess the operational effectiveness and operational suitability of the CT-II to determine if it satisfies the documented operational need, to identify system deficiencies, and to identify need for any modifications. The QOT&E will ensure that the deficiencies found during the Credible Sport OUE are corrected in CT-II.

(U) Follow-on Operational Test and Evaluation (FOT&E). After completion of QOT&E, the first CT-II aircraft will be used for FOT&E to evaluate solutions to deficiencies found during QOT&E and to develop/refine mission techniques, tactics, and doctrine.

(U) Test report published: Credible Sport II (Phase II) Operational Utility Evaluation Test Report, November 1982.

Budget Activity: 1, Combat Aircraft
Program Element: 44011F, MC-130

3. (U) Systems Characteristics: The following is a list of key performance requirements and objectives for the MC-130H CT-II aircraft:

(U) CT-II Mature Reliability, Maintainability and Availability (RM&A) Weapon System Objectives:

Characteristic	Objective/Threshold	Demonstrated
- Weapon System Reliablity	(U) 90%	TBD
- Full Mission Capable Rate	(U) 85%	
- Partial Mission Capable Rate	(U) 90%	
- Maintenance Manhours per Flying Hours	(U) 20 Hours	

(U) CT II Avionic Subsystem Objectives

Characteristic	QT&E/QOT&E	Mature	Demonstrated
- Mean Time Between Maintenance (MTBM)-Inherent (Hours)	(U) 2.0	(U) 3.0	TBD
- MTBM-Corrective (Hours)	(U) 1.5	(U) 2.2	
- Mean Time Between Removal (MTBR) (Hours)	(U) 2.4	(U) 3.5	
- Mean Manhours to Repair (MMR) (HRS) (On Equipment)	(U) 4.7	(U) 3.2	

(U) CT-II Navigation Accuracy:

Characteristics	Objective/Threshold	Demonstrated
- (U) Inertial Navigation System (INS) Position Error	.25nm/hr for 10 hours	TBD

	Elevation	Crosstrack
- (U) Terminal Guidance Accuracies		
-- (U) Forward Looking Infrared (FLIR)/Barometric (BARO)		
-- (U) Radar Mode		
-- (U) Dead Reckoning (DR) Mode		
- (U) Computed Air Release Point (CARP) Accuracies		
-- (U) FLIR/BARO		

-- (U) Accuracies for other CARP modes TBD

Budget Activity: 1, Combat Aircraft
Program Element: 44011F, MC-130

4. (U) Current Test and Evaluation (T&E):

T&E Activity (Past 12 Months)

Event	Planned Activity	Actual Date	Remarks
Test Plan Working Group (TPWG)	One per Quarter	One per Quarter	Test planning
Test Team Formation	August 1986	August 1986	Initial operational test cadre formed

T&E Activity (Next 12 Months)

Event	Planned Date	Remarks
Test Plan Working Group (TPWG) Meetings	One per Quarter	Continue test planning
Training of Test Cadre	August 1986-January 1987	Training at contractor facility
QT&E/QOT&E Plan Completed	July 1987	90 days prior to start of test
QT&E/QOT&E Start	1st Quarter FY 1988	Four aircraft in test program.

Budget Activity: <u>4, Tactical Programs</u>
Program Element: <u>44011F, AC-130U</u>

Test and Evaluation Data

1. (U) Development Test and Evaluation (DT&E): The AC-130U program procures 12 new fixed-wing gunships. The program converts planned C-130H airframes into a side-firing platform with integrated avionics, defensive systems, and weapons. No DT&E is planned for this program.

2. (U) Operational Test and Evaluation (OT&E):

(U) Previous Related Testing: The Special Mission Test and Evaluation Center of the Military Airlift Command (MAC) has completed or is conducting AC-130 related OT&E projects on low-level area saturation strafing, improved munitions (40 mm and 105 mm), improved navigation systems, electronic combat equipment improvements, and an improved low-light-level television sensor system. MAC has also evaluated the firing accuracy and temperature and vibration parameters for use in the AC-130H modification program. These test results have been used in preparing the AC-130U request for proposal and will be used in evaluating the new AC-130U.

(U) Qualification Operational Test and Evaluation (QOT&E): The AC-130U test program consists of combined Qualification Test and Evaluation (QT&E) versus DT&E/Initial Operational Test and Evaluation (IOT&E). As such, the purpose of the test is to verify specification compliance and operational requirements, identify deficiencies, and to suggest future improvements. Production decisions will have been completed prior to the availability of the test information/results; however, the risk caused by the concurrency in this program is greatly reduced by the test information from the AC-130H program. The AC-130U test program will be conducted from October 1989 through September 1990. The Aeronautical Systems Division, Director of Special Operations Forces System Program Office (ASD/AFZ), as agent for Air Force Systems Command (AFSC), the implementing command, will be responsible for the AC-130U test program as prescribed in DOD Directives 5000.1 and 5000.3, AFR 80-14, HQ USAF Program Management Directives and HQ AFSC Program Direction. The Air Force Flight Test Center will conduct the QT&E as the Responsible Test Organization and will be responsible for coordinating and integrating overall QT&E/QOT&E activities in accordance with approved test plans, the Test and Evaluation Master Plan, and guidance from the Program Office, Test Plan Working group, and Safety Review Board. The combined test force will plan and conduct ground and flight test operations. A series of tests span the developmental and operation life of the AC-130U system. The test program will combine all aircraft test objectives into a logical, time-phased program prioritized to provide adequate data to support program objectives. Combined QT&E and QOT&E will be performed to the maximum extent possible. One AC-130U aircraft will be used during the combined flight test program at Edwards AFB, CA. The test aircraft will be the first production AC-130U. Any deficiencies or improvements identified by test will be retrofitted into the production aircraft. No integration contracts have yet been awarded.

(U) Follow-On Operational Test and Evaluation (FOT&E): MAC will conduct an approximate 12-month FOT&E on the AC-130U. FOT&E will begin 30 days after delivery of the first AC-130U aircraft to MAC. The FOT&E will concentrate on evaluating solutions to previously identified discrepancies, identifying additional deficiencies, and developing and/or refining tactics and techniques for employment.

Budget Activity: Tactical Programs
Program Element: 44011F, AC-130U

3. (U) Systems Characteristics: The following is a list of key performance requirements and objectives for the AC-130U Gunship aircraft.

Characteristic	Objective/Threshold	Demonstrated
(U) Air Vehicle Performance	The AC-130U shall have performance characteristics as good as or better than performance levels of the current AC-130H.	To be determined (TBD)
(U) Avionics Performance	Full operation in any mode after a warm-up time of 10 minutes.	TBD
( ) Offensive Performance		TBD
( ) Defensive performance		TBD
( ) Target acquisition		TBD
(U) Navigation accuracy	Navigation system accuracy shall be .8 NM/hr for the first hour and .65 NM/hr for the 2d through the 10th hour.	TBD

Budget Activity: 4, Tactical Programs
Program Element 44011F, AC-130U

Characteristics	Objective/Threshold	Demonstrated
(U) Reliability		
Mission reliability (MR)	97%	To Be Determined (TBD)
Mean Flight Hours Between Failure	2.3 hrs	TBD
Mean Flight Hours Between Unscheduled Maintenance	1.1 hrs	TBD
Mean Flight Hours Between Unscheduled Repair	2.9 hrs	TBD
(U) Maintainability		
Maintenance Man Hours/Flying Hour (Organizational and Intermediate Level - excluding support)	8.4 hrs	TBD
Mean Time to Repair (On equipment)	2.6 hrs	TBD

4. (U) Current Test and Evaluation (T&E):

T&E Activity (Past 12 Months)

Event	Planned Date	Actual Date	Remarks
Program Management Directive (revised)	3 Qtr FY 1986	1 Qtr FY 1987	Review and comment
Preliminary Systems Operational Concept/ Systems Operational Concept	3 Qtr FY 1986	1 Qtr FY 1987	Review and comment

T&E Activity (Next 12 Months)

Event	Planned Date	Actual Date	Remarks
Test and Evaluation Master Plan	2 Qtr FY 1987		Assist in preparation
Test Munitions	3 Qtr FY 1987		Define and resource munitions requirements
Test Program Outline (TPO)	3 Qtr FY 1987		Provide TPO to Air Force Operational Test & Evaluation Center
Test Planning Working Group (TPWG)	3 Qtr FY 1987		Participate in TPWG
Test Resources	4 Qtr-2 Qtr FY 1987-88		Identify test team resources/requirements

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 52610F
DOD Mission Area: 223 - Close Air Support and Interdiction

Title: A-7 Squadrons (ANG)
Budget Activity: 4 - Tactical Programs

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		0	36,138	63,220	83,367	35,017	217,742
3275	A-7 Avionics Test Station Replacement	0	3,000	6,708	9,625	5,809	25,142
3606	A-7 Upgrade	0	33,138	56,512	73,742	29,208	192,600

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Project 3275 is a development effort that replaces the 20-year-old and severely degraded A-7 "Big Eight" intermediate level avionics test stations (analogous to F-16 avionics intermediate shop with new modular automatic test equipment compliant test stations that will support the A-7 through the year 2010. The A-7 aircraft will be in service through the year 2000. The aging A-7 "Big Eight" testers are rapidly becoming logistically unsupportable and unreliable and are projected to be totally unsupportable by 1990. The new, deployable test stations will provide full diagnostic and repair capability for current and planned A-7 avionics at 20 continental United States locations.

(U) The A-7 Upgrade Program, project 3606, will provide for prototype of two A-7D aircraft which would be fitted with an augmented engine, and aerodynamic improvements. This would require a stretch of the fuselage fore and aft. The end result would be a reprocurement data package sufficient for a competitive production program.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	0	4,531	5,056	N/A	16,055	25,642
Aircraft Procurement	0	0	13,200	N/A	106,200	119,400

EXPLANATION: (U) Congress reduced project 3275 in FY 1987 RDT&E funds by 1,500 with no specific Congressional language. At the same time, Congress added 35,000 of RDT&E funds in FY 1987 to initiate project 3606. Subsequent fiscal years reflect total increases in both RDT&E and Aircraft Procurement due to continued implementation of project 3606.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Aircraft Procurement:						
Funds						
Project 3275						
BP1200	0	9,000	13,200	41,200	60,100	123,500
BP1600	0	0	600	1,700	2,700	5,000
Quantities	(0)	0	(4)	(12)	(18)	(34)
Operation & Maintenance	0	(0)	600	600	500	1,700
Project 3606						
BP1100	0	0	0	600	100,000	100,000

5. (U) RELATED ACTIVITIES: Not Applicable.

6. (U) WORK PERFORMED BY: TBD

7. (U) PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 3275, A-7 Avionics Test Station Replacement: The A-7 "Big Eight" testers, fielded in the early 1960s, are severely degraded in terms of accuracy and reliability due to the wear and tear of many years of service. The original contract service life of 2000 operating hours has now exceeded 10,000 hours. The wiring is extremely brittle and degraded through countless maintenance actions and vendor parts are increasingly difficult or impossible to procure. For each hour of actual test time, approximately .65 man-hours are expended in calibration and repair of the old test equipment. Approximately 95% of the A-7 avionics line replaceable unit repairs are accomplished using this equipment. This development effort will provide modular automatic test equipment (MATE) compliant, fully deployable, test stations that will satisfy A-7 avionics diagnostic/repair requirements through the year 2010. The A-7 avionics to be supported include the inertial measurement unit, doppler navigation, head-up display, navigation-weapons delivery computer (mission computer), forward-looking radar, air data computer, and armament station control units, etc. The RDT&E funds are required for one prototype set of test stations; development of software (both test station control and support software and avionics test software); development of interface test adapters peculiar to A-7 avionics; and operational test and evaluation. The FY 1987 RDT&E funds will initiate this full-scale development program by commencing funding for development of (a) test station control and support software; (b) 26 test program sets (TPSs) consisting of individual avionics test software, interface test adapters, and cables to support A-7 avionics systems listed previously; (c) prototype test station hardware. Production funding will commence in FY 1987 to provide funding for technical and engineering data.

Program Element: 52610F Title: A-7 Squadrons (ANG)
DoD Mission Area: 223 - Close Air Support and Interdiction Budget Activity: 4 - Tactical Programs

The FY 1988 program will begin full scale development of prototype test station hardware plus control and support software. In addition, full scale development will be completed on 10 of the 45 TPSs required for performance and diagnostic testing of current A-7D/K avionics Line Replaceable Units (LRUs). Production funding will commence to provide production tooling and long lead manufacturing items and will continue through FY 1991 to provide replacement test stations to fully satisfy test requirements at 14 Air National Guard (ANG) bases; Nellis AFB Tactical Air Command; Edwards Flight Test Center Air Force Systems Command; Newark AFS Aerospace Guidance and Metrology Center; and three Air Logistics Centers. The estimate category is IV, Planning, based upon previous experience with development of Modular Automatic Test Equipment (MATE) compliant test stations for intermediate and depot level maintenance on B-52 Strategic Radar, Electro-Optical Viewing System and Offensive Avionics Systems. The cost estimating technique used was parametric and assumed a competitive procurement. The last comprehensive review of the cost estimate by the program office was January 1986. The FY 1989 program will deliver a prototype test station hardware and control software for development test & evaluation testing in the contractor's facility plus complete development of another 22 test program sets. System compatibility testing and field operational test & evaluation will be initiated. Two production test systems will be delivered to Air Force. Cost estimate category is IV based on previous experience with development of the MATE compliant test stations utilized on B-52 strategic radar upgrade. The FY 1990 RDT&E funds will be required to complete development of the remaining 13 Test Program Sets (TPSs) for a total of 45. Operational test & evaluation will be completed and initial operational capability declared. The remaining 32 production test systems, including all associated TPSs, will be delivered in FY 1990 and FY 1991.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3606, A-7 Upgrade

A. (U) Project Description: The A-7 Upgrade is a program to modernize the current A-7D and K models of aircraft. The Air Force needs a Close Air Support/Battlefield Air Interdiction (CAS/BAI) aircraft to support the Army's Air-Land Battle doctrine. The current A-7 is tasked with CAS/BAI missions and is rapidly becoming obsolete and increasingly vulnerable to the emerging counter-air threat. The modified A-7 Upgrade is a cost-effective solution to the need for a CAS/BAI aircraft. It has high payload/range, speed, manueverability, and reliability and can operate from short fields, under the weather, day or night, and achieve first pass target destruction. Mobility requirements are reduced by 53% or from 19 to 9 C-141B aircraft equivalents and a 23% reduction in maintenance personnel. Improved systems reliability and maintainability would provide a maximum break rate of 10.5%, maintenance manhour per flight hour of 15.6 and mission capable rate of 88%. The current engine would be replaced with an augmented engine. The engine bay would be configured. Approved and proposed airframe and avionics mod would be included in the final configuration of the aircraft. The approved mods are: Low Altitude Night Attack mod, Replacement Inertial Measurement System, Combined Altitude Radar Altimeter, Standard Combined Air Data Computer, and high reliability/maintenance free battery. The proposed mods are: Strakes, Augmented flaps, lift dump spoilers, Airframe Mounted Accessory Drive, 60 KVA generator, larger fuel lines, improved air conditioning system, on-board oxygen generating system, new wiring, Hands on Throttle and Stick, Data Transfer Module, improved com/nav control, and ALR-69. The RDT&E funds are required for two full scale development aircraft and the data packages for production.

Program Element: 52610F
DoD Mission Area: 223 - Close Air Support and Interdiction

Title: A-7 Squadrons (ANG)
Budget Activity: 4 - Tactical Programs

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Not Applicable.

(2) (U) FY 1987 Program: The FY 1987 RDT&E funds will initiate this prototype program by commencing funding for development of two modified A-7D's.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The FY 1988 program will continue the FY 1987 program and lead to production of two prototype aircraft and the data packages necessary for two competitive procurement production of modification kits. Avionics integration of all avionics mods will be competed and funded separately and are not part of this effort. First flight of prototype aircraft is 18 months after contract award.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The FY 1989 program will continue flight test of the two A-7D's with an augmented engine, and associated airframe and aerodynamic modifications required to provide the desired handling qualities required. It will also include extensive data reduction and data package development.

(5) (U) Program to Completion: The FY 1990 and FY 1991 RDT&E funds will be required to complete flight test.

C. (U) Major Milestones:

Milestones	Dates
(1) (U) Contract Award	March 1987
(2) (U) Prototype Development and Test	December 1989
(3) (U) Production Decision	January 1990

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63431F
DOD Mission Area: 333 - Strategic Communications

Title: Space Communications
Budget Activity: 5 - Intelligence & Communications

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		34,872	13,112	0	0	0	N/A
1227	Terminal Segment Technology	5,056	2,417	0	0	0	N/A
2028	Space Segment Technology	20,910	7,161	0	0	0	N/A
2029	Space Communications Systems Technology	8,906	3,534	0	0	0	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provided for advanced development of space communications system concepts, techniques, and technologies. Its purpose was to reduce the risk for future space communications systems by examining high risk exploratory research efforts and performing the advanced development needed to better assess their cost, schedule, and technical risk prior to committing large amounts of engineering development funds. The program provided the necessary transition step from laboratory basic research and exploratory development to the point where engineering development for a future space communications system could proceed.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	41,916	35,805	37,021	N/A	Continuing	N/A

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) EXPLANATION OF CANCELLATION OR DEFERRAL: This program was cancelled to meet revised fiscal goals. Cancellation was necessary to fund higher priority Air Force programs.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 31305F
DOD Mission Area: 312 - General Defense Intelligence Program (GDIP)

Title: Intelligence Production Activities
Budget Activity: 5 - Intelligence and Communications

1. RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT							
3081	Image Data Exploitation II (IDEX II)						

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This project is required to ensure that major USAF GDIP organizations are capable of exploiting in the Without this digital imagery exploitation capability, these organizations will to provide to intelligence data bases.

3. COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E
Other Procurement

EXPLANATION (U): Increase in procurement total estimated cost is a result of revised inflation indices and the identification of program requirements for hardware upgrade and replacement.

4. OTHER APPROPRIATION FUNDS: ($ in thousands)

Other Procurement Funds

Military Construction Funds

Program Element: 31305F
DOD Mission Area: 312 - General Defense Intelligence Program (GDIP)

Title: Intelligence Production Activities
Budget Activity: 5 - Intelligence and Communications

5. (U) RELATED ACTIVITIES: A Memorandum of Agreement (MOA) between the services and the Defense Intelligence Agency (DIA) establishes the USAF Assistant Chief of Staff, Intelligence as the Department of Defense (DOD) Executive Agent for GDIP softcopy (digital) exploitation devices. As Executive Agent, he is responsible for ensuring that the Image Data Exploitation (IDEX) II devices being developed by the Central Intelligence Agency (CIA) satisfy the operational needs of Army, Navy, USAF and Defense Intelligence Agency (DIA) GDIP organizations. The MOA outlines the management relationships among the Services and DIA and establishes the DOD National Foreign Intelligence Softcopy Steering Committee to provide management oversight, policy making and requirements definition approval. A second MOA between the executive agent and CIA establishes a DOD contingent within the CIA Softcopy Exploitation System Joint Program Office (SES/JPO) to ensure day-to-day coordination between the Softcopy Steering Committee and the CIA development effort. It also outlines management relationships between the executive agent and CIA. Within the USAF, Program Management Directive (PMD) No.3110 is the governing directive for Air Force Systems Command personnel, representing DOD, to participate in the IDEX II Program. The specific relationships of this project with other projects and program elements cannot be adequately addressed at this classification level. These relationships are addressed in the FY 1988 National Foreign Intelligence Program Congressional Budget Justification Book, Volumes II, III, and IV.

6. (U) WORK PERFORMED BY: Contractor selected in December 1984. Classification prohibits contractor identification.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3081, Image Data Exploitation II (IDEX II)

A. Project Description: Provides for development and procurement of a digital imagery exploitation system. This system is required to ensure that USAF GDIP organizations are capable of timely and efficient exploitation of the [ ] in the [ ]

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Continued engineering development for the following: an IDEX II output interface to the Fleet Intelligence Support Terminal for secondary imagery transmission of exploited imagery; IDEX II interfaces to host data base computers at Headquarters, Strategic Air Command, Fleet Intelligence Center European Atlantic Command, 497 Reconnaissance Technical Group (RTG), 480 RTG, 548 RTG and the National Photo Interpretation Center computer for the Defense Intelligence Agency (DIA); a hardcopy digitizer interface to IDEX II to input hardcopy photos; and a remote station interface for DIA terminals at the Pentagon and the Defense Intelligence Analysis Center. Design is nearing completion of the critical design phase. Accomplished hardware/software and system Critical Design Review in August 1986.

Program Element: 31305F
DOD Mission Area: 312 - General Defense Intelligence Program (GDIP)

Title: Intelligence Production Activities
Budget Activity: 5 - Intelligence and Communications

(2) (U) FY 1987 Program: Continue incorporation of DOD required capabilities into Image Data Exploitation (IDEX) II development. Continue interface development for the Navy Fleet Imagery Support Terminal, host data bases, the DIA remote terminals and continue development of the scientific and technical (S&T) graphics package to support S&T requirements. DOD RDT&E funding levels for IDEX II were established and agreed upon in a three-party Memorandum of Agreement signed by the GDIP Program Manager in 1983. Program is in full scale development.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: RDT&E funding will complete development S&T graphics package and the interface for the DIA remote terminals. The RDT&E estimate was based upon the results of two competitions (architectural design and a preliminary design competition). The data received from the competitions is considered very reliable. As a result, our cost estimating category is Mature, Category II. RDT&E will be complete in FY 1988 with system initial operational capability in December 1988.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Not applicable. RDT&E projected for completion in FY 1988.

(5) (U) Program to Completion: Remaining outyear tasks include: completion of system fabrication, system integration, checkout and testing, system-specific training, and delivery. System final operational capability in October 1990.

C. (U) Major Milestones:

Milestones		Dates
(1) (U) Source Selection		January 1985
(2) (U) Preliminary Design Review		June 1985
(3) (U) Critical Design Review (CDR)	*(Mar-Jun 1986)	August 1986
(4) (U) Initial Operational Capability (IOC)	*(October 1988)	December 1988
(5) (U) Full Operational Capability (FOC)	*(August 1990)	October 1990

* Date presented in FY 1987 Descriptive Summary

(U) Explanation of Milestone Changes

(3), (4), and (5) (U) The CDR, IOC, and FOC slipped because the lead development and acquisition agency experienced budgetary and program changes that delayed design and full scale development thereby delaying production.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 31357F
DOD Mission Area: 312 - General Defense Intelligence Programs

Title: NUDET Detection System (NDS)
Budget Activity: 5 - Intelligence and Communications

1. RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT							

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Strategic Air Command and Aerospace Defense Command require a highly survivable capability to detect, locate, and report nuclear detonations (NUDETS) on a global basis in near-realtime. The NUDET Detection System (NDS) (formally known as the Integrated Operational NUDET Detection System (IONDS) consists of sensors on the operational 18-satellite Navstar Global Positioning System (GPS). NUDET information supports post-impact selection of appropriate retaliatory options in response to a nuclear attack against North America, as well as strike confirmation, and damage assessment. NUDET detection information is vital to the effective management of U.S. forces through the trans- and post-attack phases of any nuclear conflict. Reports to command centers of weapon effectiveness will be vital in managing strategic reserve forces and re-establishing a command structure. NDS data could be a major information component during negotiations to terminate a nuclear conflict.

3. COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E
Missle Procurement

EXPLANATION: (U) The increase of FY 1988 funds reflects a restructured program for the competitive development of NDS equipped GPS replenishment satellites slipped 24 months due to Shuttle standdown.

4. OTHER APPROPRIATION FUNDS: ($ in thousands)

Missile Procurement:
Funds
Quantities

5. RELATED ACTIVITIES: NDS sensors are flown on all Global Positioning System (GPS) satellites (PE 35165F) beginning with the NDS/GPS launch in July 1983. Development and production of the X-ray and optical NUDET sensors

for NDS are funded by the Department of Energy, [ ] PE 12433F develops and integrates the NDS electromagnetic pulse sensor into the GPS spacecraft, develops the ground/airborne user terminals, and produces the ground user terminals. Production of the airborne NDS terminals, to begin in FY 1991, will be funded in the Worldwide Airborne Command Post, PEs 11312F and 32015F.

6. WORK PERFORMED BY: System development and procurement is accomplished by Air Force System Command's Space Division, Los Angeles AFS, CA [ ]
Rockwell International, Seal Beach, CA integrates NDS sensors on GPS satellites and produces the Electromagnetic Pulse (EMP) sensor. Ford Aerospace and Communications Corporation, Palo Alto, CA, and the Aerospace Corporation, El Segundo, CA, provide systems engineering support. Sandia National Laboratories, Albuquerque, NM, and Los Alamos National Laboratory, Los Alamos, NM, are under contract to the Department of Energy (DOE) to produce the X-ray and optical nuclear detonation detection sensors. Texas Instruments, Dallas, TX, is developing and will produce the user terminals. E-Systems, Garland, TX, is developing the EMP receiver/processor for the satellite.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 31357F, NUDET Detection System

A. Project Description: The NDS payload consists of X-ray, optical, and electromagnetic pulse sensors on the operational eighteen satellite Navstar Global Positioning System (GPS) constellation. These sensors, when coupled with the extremely precise GPS timing capability, will provide location of nuclear bursts worldwide [ ] This project integrates the X-ray and optical sensor packages into the GPS satellites. Nuclear detonation data are transmitted directly to NDS users. The data are also cross-linked to other GPS/NDS satellites which act as relay points. This cross-linking of information, when used with 18 satellites, will allow a user on one side of the earth to receive data on a detonation on the opposite side. It also provides multiple redundancy of the data transmission for increased system availability and survivability. A broad range of users (National Command Authorities, Strategic Air Command, Aerospace Defense Command, other Unified and Specified Commands, [ ] will receive NUDET data direct from the spacecraft on precise location, yield, count, time, and height of burst.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: NDS Payloads were installed on the final four validation phase GPS spacecraft. The last development satellite was successfully launched in October 1985. The FY 1986 program continues integration engineering supporting the Department of Energy (DOE) provided NDS sensors on GPS production satellites.

(2) FY 1987 Program: On orbit support for the existing validation phase satellites will continue. Integration engineering support for the DOE provided sensors on the GPS production satellites will continue. [ ]

Program Element: 31357F
DOD Mission Area: 312 - General Defense Intelligence Programs

Title: NUDET Detection System (NDS)
Budget Activity: 5 - Intelligence and Communications

[ ]

(3) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The FY 1988 program will continue to provide engineering support for on-orbit satellites. [ ] and results will be used to develop second sources for key satellite payload boxes. These second sources will provide a foundation for competing the development and production of NDS equipped Global Positioning Sytyem (GPS) replenishment satellites. Costs for the NDS satellite sensor payload are based on previous NDS satellite sensor payload development efforts and are category II, mature, estimates.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The effort developing second sources for key NDS payload boxes will conclude. The development efforts for developing the NDS sensor payload equipped GPS replenishment satellites will begin. These satellites are required for launch in FY 1995 in order to maintain the NDS/GPS satellite constellation. This need date is consistent with the 24 month Shuttle standdown and DOD launch manifest (Shuttle and Delta II). The same cost estimate categories apply as in FY 1988.

(5) (U) Program to Completion: This is a continuing program. NDS design and production are keyed to the the GPS schedule.

C. (U) Major Milestones:

Milestones		Dates
(1) (U) Defense Systems Acquisition Review Council II		June 1979
(2) (U) Begin Satellite Production		August 1982
(3) (U) Launch 1st GPS/NDS Spacecraft		July 1983
(4) (U) Launch 1st Operational Satellite	*(1st Quarter FY 1987)	1st Quarter FY 1989**
(5) (U) Achieve Worldwide 2-Dimensional NUDET Location Capability	*(1st Quarter FY 1988)	4th Quarter FY 1989**
(6) (U) Achieve Worldwide 3-Dimensional NUDET Location Capability	*(2nd Quarter FY 1989)	4th Quarter FY 1990**

* Date presented in the FY 1987 Descriptive Summary.
** Launch dates and NDS capabilities are based on the Delta II contractor's proposal and the current DOD launch manifest.

(U) Explanation of Milestone Changes

(4) (5) (6) (U) First launch of an operational satellite and NDS operational capabilities slipped because of 24 month Shuttle standdown.

8. (U) PROJECTS OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

PE: 31357F

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 33110F Title: Defense Satellite Communications System (DSCS)
DOD Mission Area: 333 - Strategic Communications Budget Activity: 5 - Intelligence and Communications

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		7,077	16,833	21,398	53,596	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Defense Satellite Communications System (DSCS) provides super high frequency satellite communications for secure voice and high data rate transmissions. It satisfies the unique and vital national security communications requirements of worldwide military command and control, crisis management, relay of intelligence and early warning data, treaty monitoring and surveillance information, and diplomatic traffic. Specifically, the DSCS supports the National Command Authorities, the Worldwide Military Command and Control System, the Defense Communications System, the Diplomatic Telecommunications Service, the White House Communications Agency and mobile forces of all Services. There will be a continuing requirement for this communication service.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMAARY: ($ in thousands)

RDT&E	6,753	14,001	12,531	N/A	Continuing	N/A
Missile Procurement	141,066	122,671	65,389	N/A	Continuing	N/A

EXPLANATION: (U) Space Launch Urgent Supplemental provided $.9 million and $6.0 million in FY 1986 and 1987 RDT&E respectively. Missile Procurement Funds added for FY 1986-89 to implement Space Launch Recovery, including satellite storage and compatibility with Titan IV. The remaining differences are due to Congressional reductions.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

Missile Procurement:						
Funds	129,021	110,453	75,870	21,105	Continuing	N/A
Quantities	2	2	1	0	Continuing	N/A

Program Element: 33110F
DOD Mission Area: 333 - Strategic Communications

Title: Defense Satellite Communications System (DSCS)
Budget Activity: 5 - Intelligence and Communications

5. (U) RELATED ACTIVITIES: The Defense Communications Agency is responsible for overall Defense Satellite Communications System program management, system engineering, and satellite operational direction. The Army develops and procures ground terminals under PE 33142A, Defense Satellite Communications System. The Navy procures shipborne terminals under PE 33109N, Satellite Communications System. In addition to its responsibility for the space segment, the Air Force develops and integrates airborne terminals under PE 11312F, Post Attack Command and Control System, and PE 32015F, National Emergency Airborne Command Post. The Air Force also provides launch services for the Titan III launch vehicle under PE 35119F, Space Boosters. Inertial Upper Stage procurement and recurring integration and Space Shuttle launch support will be furnished under PE 35171F, Space Launch Support. The Advanced Space Communications Program, PE 63431F, develops and demonstrates evolutionary communication satellite technologies for future satellite programs. The Air Force also has funding for ground equipment, construction, operation and maintenance, and manpower to support its portion of the ground segment in PE 33605F, Satellite Ground Terminals and 63735F, Worldwide Military Command and Control System Architecture.

6. (U) WORK PERFORMED BY: The Air Force Space Division, Los Angeles, CA, is responsible for the space segment of the Defense Satellite Communications System. TRW, Redondo Beach, CA, is the prime contractor for the DSCS II satellites. General Electric Company, Valley Forge, PA, is the prime contractor for the DSCS III spacecraft. The Aerospace Corporation, El Segundo, CA, provides general systems engineering and integration to the Air Force Space Division System Program Office.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not applicable

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3?110F, Defense Satellite Communications System

A. (U) Project Description: See paragraph 2. Acquire DSCS satellites to support the wideband, high data rate communication requirements of DOD and other national security activities.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Multiyear contract continued with full funding of satellites III-B10 and III-B11 as well as advance procurement for non-long lead parts, materials, and subcontractor sub-assembly fabrication for the next five satellites. Began first-time integration onto the Titan IV. Satellites II-E15, III-A2, -A3, and III-B6 completed system testing.

Program Element: 33110F
DOD Mission Area: 333 - Strategic Communications

Title: Defense Satellite Communications System (DSCS)
Budget Activity: 5 - Intelligence and Communications

(2) (U) FY 1987 Program: Acquisition of the seven multiyear satellites will continue with two more satellites, III-B12 and -B13, fully funded. RDT&E will continue on the Titan IV first-time integration as well as the design changes for the DSCS satellites to be procured after the current multiyear procurement. Studies and system requirements reviews for satellites acquired after the last multiyear procurement will be conducted. Initial brass-board models and system specifications will also be developed. Satellite III-B7 completes system testing. Pending recovery of space launch capability, all delivered DSCS satellites are maintained in storage with periodic inspection and maintenance.

(3) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The last multiyear DSCS III satellite, III-B14, will be funded. Satellites III-B8 and -B9 are delivered
Remaining delivered satellites continue in storage. Storage and Titan IV integration will continue along with advanced development of satellite upgrades. Emphasis will be placed on completing all system engineering and acquisition planning associated with concept definition and validation to allow the DSCS III-C15 development contract to be awarded in FY 1989. The cost estimate category is III, Budgetary.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: First-time integration on the Titan IV will be completed with DSCS now being dual compatible with Space Shuttle as the prime launch vehicle and Titan IV as backup. The contract for development flight satellite (DFS) III-C15 will be awarded. This satellite will have a major improvement in terms of jam resistant throughput capacity and an integrated, competitively acquired upper stage. New high power amplifiers will be developed and integrated into the communications payload, along with new/improved jammer nulling antennae. Although the communications payload will contain no message handling ability, it will likely contain modest signal processing techniques like frequency dehopping and rehopping. Minimal changes will be made to the satellite bus. These changes will primarily be directed to the increased electrical power requirements, such as additional batteries and solar cells and associated changes to the power distribution and control subsystem. Satellites III-B10 and -B11 are delivered and placed in storage with the previously mentioned DSCS satellites. The cost estimate category is III, Budgetary.

(5) Program to Completion: DSCS III satellites will be launched on the space shuttle
DSCS III-C15 development will continue with a tentative pending launch capability and priority. Satellites III-C16, -C17 and -C18 will be procured at the rate of one per year starting in FY 1993.

Program Element: 33110F | Title: Defense Satellite Communications System (DSCS)
DOD Mission Area: 333 - Strategic Communications | Budget Activity: 5 - Intelligence and Communications

C. Major Milestones:

		Milestones	Dates
		Defense Satellite Communications System II	
(1)	(U)	Initial Contract Award	March 1969
(2)	(U)	Initial Satellite Launch	November 1971
(3)	(U)	Launch of Final Production Satellite (with DSCS III-A1)	October 1982
(4)		Remaining Satellite Launch (with DSCS III-A2)	[ ]
		Defense Satellite Communications System III	
(1)	(U)	Defense Systems Acquisition Review Council I	December 1974
(2)	(U)	Award Phase I (Preliminary Design) Contracts	December 1975
(3)	(U)	Defense Systems Acquisition Review Council II	December 1976
(4)	(U)	Award Phase 2 (Engineering Development) Contract	February 1977
(5)	(U)	Defense Systems Acquisition Review Council III Production Decision	December 1981
(6)	(U)	Launch First Demonstration Flight Satellite	October 1982
(7)	( )	First Production Satellite Launches on Shuttle	[
(8)	( )	Refurbished qualification satellite launch availability	
(9)	( )	Full complement of orbiting DSCS III's (seven)	]
(10)	(U)	Delivery of last DSCS III multiyear procured satellite	March 1991
(11)	( )	Launch availability of DSCS III-C15	[ ]

Explanation of Milestone Changes: All [ ]
Less important DSCS III milestones (Preliminary Design Review and III-A2 launch) no longer shown as downstream DSCS activities become more important and better defined.

9. (U) COOPERATIVE AGREEMENTS: Not applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 33126F
DOD Mission Area: 393 - Long Haul Communications

Title: Long Haul Communications - DCS
Budget Activity: 5 - Intelligence and Communications

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		14,028	5,442	5,154	4,756	Continuing	N/A
2022	Automated Digital Communications Processing Techniques	3,178	2,079	2,122	1,759	Continuing	N/A
2155	Systems Control	3,543	2,072	1,816	1,760	Continuing	N/A
2157	Transmission Improvements	6,927	911	1,036	1,057	Continuing	N/A
2206	Digital European Backbone (DEB)	200	190	180	180	Continuing	N/A
2440	Secure Telephone Systems (STS)	180	190	0	0	0	2,460

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element is the Air Force portion of the Tri-service RDT&E program for communications networks, including the Defense Communications System (DCS). The DCS provides the long distance, common user, switched telecommunications network to satisfy requirements of the National Command Authority, the Department of Defense, and certain other government agencies. This RDT&E program defines system architectures, specifies design parameters, and develops communications technology for modernization and improvements of communications networks, including the DCS. Work in this program element provides for an orderly transition to a second generation DCS and determines the architecture for the third generation DCS. The second generation DCS is characterized by digital transmission and switching subsystems. The focus for the third generation DCS will be on unified direction and control and subsystem interaction between differing switched networks (e.g., voice and data). This program element includes technology development in automated digital communications processing and distribution techniques, performance assessment and network management, and transmission improvements.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	11,249	5,630	5,264	N/A	Continuing	N/A
Other Procurement	34,502	37,252	29,919	N/A	Continuing	N/A

EXPLANATION: (U)
FY 1986: RDT&E funds increased to fund a special modulation/demodulation (modem) project.
FY 1987 and FY 1988: RDT&E funds slightly reduced to fund higher priority Air Force projects.
FY 1986: Other Procurement funds reduced by Gramm-Rudman-Hollings actions and to fund higher priority programs.
FY 1987 and FY 1988: Other Procurement funds reduced to fund higher priority programs.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Other Procurement:						
TOTAL	24,362	21,721	24,837	24,102	Continuing	N/A
Project 2206 (Digital European Backbone)						
Funds	21,708	16,700	22,988	24,102	Continuing	N/A
Quantities	Not Applicable					
Project 2440 (Secure Telephone Systems)						
Funds	2,654	5,021	1,849	0	0	9,524
Quantities	Not Applicable					
Military Construction:						
Project 2206 (Digital European Backbone)						
Funds	552	7,750	3,800	1,220	Continuing	N/A

5. (U) RELATED ACTIVITIES: The Digital European Backbone (DEB) project (2206) involves Tri-Service funding and includes installation of equipment at Army, Navy, and Air Force sites. Overall program management for this project is exercised by the Defense Communications Agency (DCA). DCA's Management Engineering Plan (MEP) tasks the Army to procure the digital radios and multiplexer equipment. The MEP tasks the Air Force to develop and procure the digital troposcatter modem. Acquisition of communications security equipment through the National Security Agency to support Project 2440 is funded under Program Element 33401F, Communications Security. RDT&E for the Secure Conferencing Project, part of Secure Telephone Systems, is funded under Program Element 63735F, Worldwide Military Command and Control System Architecture.

6. (U) WORK PERFORMED BY: Air Force Systems Command manages this program element through the Electronic Systems Division (ESD), Hanscom Air Force Base, MA (Projects 2206 and 2440) and the Rome Air Development Center (RADC), Griffiss AFB, NY (Projects 2022, 2155 and 2157). ESD receives technical support from the MITRE Corporation, Bedford, MA and Computer Engineering Associates, Avon, MA. Major contractors for Project 2206 are TRW, San Luis Obispo, CA and GTE, Needham, MA. Major contractors for projects 2022, 2155, and 2157 are: Computer Sciences Corporation, Falls Church, VA; Honeywell, Tampa, FL; RCA, Camden, NJ; and, Signatron Inc, Lexington, MA. All of these support the tasks managed by RADC. Other contractors are: Digital Communications Corporation, Germantown, MD (Project 2157); Western Union, McLean, VA (Project 2022); Ford Aerospace and Communications Corporation, Colorado Springs, CO (Project 2022); Harris Corporation Melbourne, FL (Project 2157); Hazeltine, Greenlawn, NY (Project 2157); and Raytheon, Sudbury, MA (Project 2157).

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 2022, Automated Digital Communications Processing. As the Defense Communications System (DCS) transitions from an analog to an all digital system, new capabilities will emerge. Systems to exploit these capabilities will be designed and tested under this project. First is a Multinet Gateway device which will enable multilevel secure interfaces between the DCS and other digital networks (e.g., commercial systems). The ability to connect the DCS to other digital networks in a secure way will significantly improve survivability by providing more alternate routing possibilities should segments of the DCS fail in crisis situations. Second is an initial series of tests to define and evaluate performance parameters for the Defense Switched Network, the follow-on to the current Automatic Voice Network (AUTOVON). In FY 1986, adaptive routing, use of mixed transmission media (e.g., satellite and terrestrial), and multilevel priority and preemption concepts continued to be evaluated using the experimental integrated switched network located at Rome Air Development Center (RADC). In FY 1986, advanced development multinet gateway models were delivered to the Defense Communications Agency (DCA) for extensive testing in an internet environment. Additional security certification work on the multinet gateway device is scheduled for FYs 1987 and 1988. Certification work will be completed in late FY 1988. In FYs 1987 and 1988, in-house and contractual efforts to evaluate voice/data integration technologies, including integration methods using circuit-switched, hybrid-switched, and packet-switched approaches, will continue. Beginning in FY 1988, RADC will initiate studies and investigations to define advanced network concepts involving such disciplines and technical areas as advanced switching technologies, network operating systems, and routing and information flow control. Beginning in FY 1988 and continuing into FY 1989, RADC will develop and demonstrate technologies for multi-media (e.g., voice, facsimile, data, and video) user applications. Areas of emphasis will include highly intelligible, low data rate voice encoding schemes, multimedia work stations, and multilevel secure terminals.

B. (U) Project: 2155, Systems Control. This project will improve DCS network management and control by developing techniques, hardware, and software to provide improved performance assessment, failure detection, failure isolation and reporting, and restoral and reconstitution on a worldwide basis. In FY 1986, the Air Force continued to integrate the AUTOVON Network Control Subsystem capabilities into the AUTOVON Network Data Control System. A second major effort is the design effort for the Base Information System Management Center which began in FY 1986. This effort will be completed in FY 1987. Results will be given to the Air Force Communications Command for incorporation into the Base Information Digital Distribution System. In FY 1987, RADC will begin to develop operational concepts, deployment strategies, and software programs to permit multiple Digital Patch and Access units within a subregion to be netted together for real-time coordinated operation. A continuing effort through FY 1989 is evaluating the feasibility of using selected commercial equipment in DoD communications networks.

C. (U) Project: 2157, Transmission Improvements. This project will improve transmission, survivability, efficiency, capacity, and reliability of Air Force and DCS communications links by applying new techniques such as millimeter wave and fiber optics, and by developing equipment embodying new Electronic Counter-countermeasures (ECCM) technology. In FY 1986, vulnerability assessment of DCS troposcatter and microwave radios continued. Results will be incorporated into ECCM developments for both media. Additionally, three other major developments will continue in FYs 1986 and 1987. These are narrowband high frequency radio with jam resistance, high data rates, and improved voice

recognition features; an advanced development model of multinode, multirate digital microwave radios with ECCM features, including adaptive antenna nulling; and a high power amplifier for troposcatter radios which will increase efficiency up to 70 percent and reliability by 300 percent. In FY 1986, development of a troposcatter angle diversity retrofit kit for use in Digital European Backbone (DEB) radios continued. This kit will employ advanced diversity combining techniques to more efficiently use the frequency spectrum. This effort will be completed in FY 1988. In FY 1988, Rome Air Development Center (RADC) will initiate development of algorithms and protocols, with required hardware and software for implementation, to provide multi-band transmission capabilities embodying a combination of diverse propagation media and network communications subsystems. Beginning in FY 1989, RADC will apply emerging technologies, such as artificial intelligence, optics, and very high speed integrated circuitry, to develop, test, and demonstrate a sentient radio system.

D. (U) Project: 2206, Digital European Backbone (DEB). DEB is the approved program for digital upgrade of the Defense Communications System (DCS) in Europe. The program stems from the National Command Authority's direction to secure DCS links, the rapid growth of high speed data requirements, and major force deployments in Europe, such as the Ground Launched Cruise Missile. One phase of DEB was completed in 1979. The remainder of DEB is planned to use the DCS standard digital radio and multiplex equipment known as DRAMA. The first segment of DEB using DRAMA equipment became operational in June 1984. The remainder of the DEB upgrade will extend the improved operation from the Northern Atlantic to Italy and Spain. In FY 1986, several radio links in Germany and Belgium were digitized and bulk encrypted. In FYs 1987, 1988, and 1989, the majority of the installations will be in the United Kingdom. The upgrade is scheduled to be completed in the mid-1990's. The Air Force is the lead military department for the overall upgrade.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not applicable.

9. (U) COOPERATIVE AGREEMENTS: Not applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 33128F
DOD Mission Area: 393 - Long Haul Communications and the NCS

Title: Inter-Service/Agency Automated Message Processing Exchange (I-S/A AMPE)
Budget Activity: 5 - Intelligence and Communications

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		24,471	52,408	1,296	13,240	7,155	98,570

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Department of Defense requires responsive and cost effective message communications services. These services must support the requirements of the National Command Authorities, the Joint Chiefs of Staff, Unified/Specified Commands, the Military Departments, and other DOD and US government agencies. To better meet these user requirements, the I-S/A AMPE program was established by Assistant Secretary of Defense (Command, Control, Communications, and Intelligence) memorandum, 11 October 1978, "Integrated AUTODIN System Architecture Report." The I-S/A AMPE will provide a combined Defense Special Security Communication System/General Service (DSSCS/GENSER) accredited, standard base-level automated message processing exchange (AMPE) capability; and an interface to the Defense Data Network (DDN). The I-S/A AMPE will be a standard telecommunications element for critically needed secure message communications services required by the widely dispersed DOD elements in peace and war.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	30,600	54,567	9,336	N/A	5,570	100,073
Other Procurement	1,472	0	0	N/A	157,128	158,600

EXPLANATION: (U) RDT&E Appropriation:

FY 1986: Revised by Gramm-Rudman and RDT&E undistributed reductions.

FY 1987: Undistributed Congressional reduction.

FY 1988: Reduction to properly align fiscal year requirements and funding.

Program Element: 33128F
DOD Mission Area: 393 - Long Haul Communications and the NCS

Title: Inter-Service/Agency Automated Message Processing Exchange (I-S/A AMPE)
Budget Activity: 5 - Intelligence and Communications

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Other Procurement:						
Funds	1,184	0	0	14,757	143,451	159,392
Quantities	0	0	0	6	37	43
Military Construction:						
Funds	0	0	12,650	9,250	42,664	64,564

5. (U) RELATED ACTIVITIES: The following Program Elements support the I-S/A AMPE program: Communications Security, PE 33401F; Air Force Communications Command Engineering and Installation, PE 35123F; BLACKER program, funded by the National Security Agency; and Long-Haul Communications (Defense Data Network program), PE 33126F; Navy, PE 33128N; Army, PE 33128A; and Defense Agencies, PE 33128S.

6. (U) WORK PERFORMED BY: The Automated Systems Program Office has responsibility for the program. This is an Air Force Communications Command organization located at Gunter Air Force Station, Alabama. The primary contractor is TRW, Redondo Beach, CA.

7. (U) PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 33128F, Inter-Service/Agency Automated Message Processing Exchange (I-S/A AMPE)

A. (U) Project Description: The I-S/A AMPE program is an element of the Integrated AUTODIN System Architecture. The I-S/A AMPE will provide the Services and Agencies with common digital message and record data capabilities for world-wide deployment. The I-S/A AMPE will replace the unique Service and Agency Automated Message Processing Exchanges (AMPEs) and potentially the Defense Intelligence Agency's Communications Support Processor (CSP). Systems currently in use are the Navy's Local Digital Message Exchange, Army's Automated Multi-Media Exchange, Air Force's Automated Message Processing Exchange, and the National Security Agency's STREAMLINER. In addition, I-S/A AMPE will provide the capability to functionally replace the 15 AUTODIN Switching Centers (ASCs). I-S/A AMPE will use the Defense Data Network (DDN) as its backbone transmission system. Major systems design features include: a store and forward message service comparable to the service provided by the current AMPEs and ASCs; interfaces to external AUTODIN terminals and other selected systems; an interface to the DDN through BLACKER program encryption devices; use of Trusted Computing

Program Element: 33128F
DOD Mission Area: 393 - Long Haul Communications and the NCS

Title: Inter-Service/Agency Automated Message Processing Exchange (I-S/A AMPE)
Budget Activity: 5 - Intelligence and Communications

Base security technology to provide an access control mechanism for the processing of classified traffic at multiple security levels and compartments; capability to process both Defense Special Security Communications Systems (DSSCS) and General Service (GENSER) message traffic; and the use of High Order Language and modularity concepts in the design of all software. The Air Force has adopted a parallel and interlocked two track approach to achieve program objectives. Track I will acquire a DOD standard base-level AMPE system and provide for an AUTODIN Switching Center functional replacement. Track II will provide for a full DSSCS/GENSER accreditable system through Preplanned Product Improvement techniques.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: The 44-month design period continued. The System Design Review was conducted in May 1986., The FY 1986 effort included the System Engineering Management Plan, System Specification, Computer Program Development Plan, Integrated Support Plan, Configuration Management Plan, Configuration Audit Plan, Inspection System Program Plan, Reliability Program Plan, System Safety Program Plan, Human Engineering Program Plan, Contractor Data Management Plan, Technical Manual Publication Plan, Support Equipment Plan, Subsystem Design Analysis Report, System Design Review, Human Engineering System Analysis, System Security Plan, Security Model, and Security Design Analysis.

(2) (U) FY 1987 Program: The 44-month design period will continue through FY 1987. The design effort will continue with the system component development, integration, and component qualification testing. The planned efforts include the Critical Design Review, Computer Program Component development/coding, Accreditation Test Plan, Vulnerability Analysis, Human Engineering Test Plan, Common Data Base Design Specification, Computer Program Development Specification, Configuration Item Development Specification, Computer Program Product Specification, technical manuals, Qualification Testing and Evaluation of the hardware and software components. Also, the preliminary and critical design reviews will be completed. Additional efforts will ensure conformance with the subsystem specification and requirement traceability matrix.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The 44-month design period will continue through FY 1988. Design efforts will continue with the development of Configuration Items and Computer Program Configuration Items. Preliminary Qualification Test and Formal Qualification Test procedures will be developed to support qualification testing and evaluation of individual hardware and software components. Functional testing of Configuration Item and Computer Program Configuration Item elements will continue. Preliminary Qualification Testing of critical functions will be continued leading up to Formal Qualification Testing of Computer Program Configuration Items (CPCIs) to support the ongoing system integration efforts. Electro-Magnetic Interference and TEMPEST testing will be completed. Product Verification Review will be completed and the prototype and test phase of the I-S/A AMPE will begin. System Development Test and Evaluation of the I-S/A AMPE at the contractor's location and at the Gunter Prototype and Test Facility installation will be completed and initial phases of the Initial Operational Test and Evaluation (IOT&E) efforts will begin. Interoperability testing will be performed during this period and penetration testing of the system will be started concurrent with the IOT&E.

Program Element: 33128F
DOD Mission Area: 393 - Long Haul Communications and the NCS

Title: Inter-Service/Agency Automated Message Processing Exchange (I-S/A AMPE)
Budget Activity: 5 - Intelligence and Communications

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The 44-month design period will continue into FY 1989. The Air Force Operational Test and Evaluation Center will complete system Initial Operational Test and Evaluation. Penetration testing will continue throughout the second quarter of FY 1989. The government will conduct the Functional Configuration Audit, the Physical Configuration Audit, and the System Validation Review. These will be followed by the Joint Requirements Management Board Milestone III decision and the Production Buy Decision. Implementation of the I-S/A AMPE mission systems will begin in FY 1989 and continue through FY 1994.

(5) (U) Program to Completion: Not applicable. I-S/A AMPE RDT&E efforts will be completed in FY 1989.

C. (U) Major Milestones:

Milestones		Dates
(1) (U) Justification for Major System New Start		March 1983
(2) (U) Milestone I Decision (Air Force Systems Acquisition Review Council)		January 1984
(3) (U) Milestone II Decision (Defense Systems Acquisition Review Council)		July 1985
(4) (U) Contract Award (Design Phase)		August 1985
(5) (U) System Design Phase Start		August 1985
(6) (U) Subsystem Design Phase Start		August 1985
(7) (U) Prototype and Test Phase Start		April 1988
(8) (U) Qualification Operational Test and Evaluation Start		October 1988
(9) (U) Milestone III Decision (Joint Requirements Management Board)		April 1989
(10) (U) Production Buy Decision (Source Selection Authority)	*(April 1989)	May 1989
(11) (U) Initial Operational Capability	*(September 1989)	October 1989

*Date presented in FY 1987 Descriptive Summary.

(U) Explanation of Milestone Changes

(10) (U) The Production Buy Decision must be delayed one month to reflect the time consumed in the Milestone III decision process.

(11) (U) Initial Operational Capability slipped 30 days because the actual contract award was one month later than planned.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 33144F Title: Electromagnetic Compatibility Analysis Center (ECAC)
DOD Mission Area: 360 - Support & Base Communications Budget Activity: 5 - Intelligence and Communications

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		7,104	7,485	8,132	8,618	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The ECAC is a Department of Defense (DOD) Center administered by the Air Force. The success of strategic and tactical forces requires that communications-electronic (C-E) equipment supporting command, control, communications, and intelligence (C^3I) function as intended in its operating environments. The following tasks support this objective:

A. (U) DOD Frequency Management and Engineering Support System: This system provides direct operational support to strategic and, eventually, tactical units of the DOD through a reliable, distributed, computer-aided, worldwide frequency management information and engineering support system. ECAC is responsible for the development and maintenance of the joint component of this system, known as the Frequency Resource Record System.

B. (U) Joint Operations Planning: Provides direct assistance to the Joint Chiefs of Staff (JCS) and the Unified and Specified Commands in determining the frequency resource requirements, joint operations frequency management capabilities, and deconfliction procedures necessary to ensure that C-E equipment supporting C^3I, electronic warfare and intelligence functions will operate as required without suffering electromagnetic interference.

C. (U) DOD EMC Technology Transfer Program: Provides operating units with EMC engineering capabilities through the development and maintenance of software for generally available computers.

D. (U) Projects: Provides direct support to system acquisition program management offices in designing and evaluating C-E equipment's ability to function in its planned operating environments.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
RDT&E	7,256	7,670	8,067	N/A	Continuing	N/A

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

Operation and Maintenance: Funds	4,938	4,656	4,895	5,102	Continuing	N/A

5. (U) RELATED ACTIVITIES: None.

6. (U) WORK PERFORMED BY: The IIT Research Institute at Annapolis, Maryland, under contract through the Electronic Systems Division, Air Force Systems Command.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 33144F, Electromagnetic Compatibility Analysis Center.

A. (U) Project Description: Policy and guidance for the operation of ECAC is provided by the Chairman, Joint Chiefs of Staff, and the Assistant Secretary of Defense for Command, Control, Communications, and Intelligence (C^3I). The Air Force is responsible for planning, budgeting, and administration. RDT&E and Operation and Maintenence funds provided under PE 33144F cover the development and maintenence of the worldwide DOD Frequency Management Information and Engineering System, the analysis of the capability of communication-electronics equipment to perform C^3I and other electronic functions in support of frequency allocation for the Military Communications Electronics Board, the transfer of electromagnetic compatability technology to elements in the field, and the development of data bases and analytical capabilities. Acquisition programs also provide $30 million per year to support analyses of their specific systems.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments:

(a) (U) DOD Frequency Management and Engineering Support System: Phase I of the Frequency Management and Engineering Improvement Plan was accomplished, providing the Frequency Management Offices of the Services with remote hookups to the Master DOD Frequency Assignment File at ECAC. Detailed design of the system upgrade to connect

Commander-in-Chief, European Command, and Commander-in-Chief, Pacific Command, elements to the system was completed. Over 120,000 radio frequency assignment transactions were processed by the Center.

(b) (U) Joint Operations Planning: The Center's Sensitive Compartmented Information Facility became operational. Acquisition of a Sperry 1100/92SV computer to replace the aging Sperry 1100/82 was initiated. The Center updated its "Blue" (US) and "Gray" (all other countries besides Warsaw Pact) data bases describing the location and uses of communications-electronics (C-E) equipment and its technical characteristics. The Tactical Environment Generation System, which enables tacticians to generate tactical C-E equipment "laydowns" for contingency scenarios with much greater speed and efficiency, reached initial operating capability. Initial computer code generation for the Tactical Environment Analysis Model, an analysis capability which predicts the battlefield performance of tactical very-high-frequency communications nets, was completed. One-hundred-fifty-six Frequency Allocation Requests for new C-E equipment (42 radars, 114 communications) were reviewed for the Military Communications Electronics Board. ECAC completed the first tier (system-level data) and, for synchronous satellites, the second tier (basic technical characteristics) of the Space Systems Data Base, which provides the capability to plan the deployment of new satellites so as to minimize electromagnetic interference with satellites already on orbit.

(c) (U) DOD EMC Technology Transfer Program: ECAC modified several of its computer models, which had been previously developed or upgraded in-house with institutional funds, so that they were usable by other DOD components for electromagnetic compatibility (EMC) analysis. These models included the Tactical Data Base System for the US Army Battlefield Electromagnetic Environment Office; the Path Loss Line-of-Sight Model (PLLM), the Terrain Integrated Rough Earth Propogation Prediction Model, the Exercise Support Program, the High-Frequency Ground Wave Propogation Model, the Frequency-Dependent Rejection Model, and the Prophet Evaluation System for the US Army Information System Support Activity; and the PLLM and the C-E Warfare Evaluation Model for the Joint Electronic Warfare Center. In addition, ECAC provided off-the-shelf EMC analysis software to the US Air Force Frequency Management Office.

(d) (U) Projects: ECAC executed 188 tasks in support of system project offices, operational commanders, and frequency managers. Air Force programs supported included the Global Positioning System, Milstar, North Warning System, Air Launch Control System, Improved Minutemen Physical Security System, and projects for the 554th Range Group. For the Army, the Center supported Regency Net, the Mobile Subscriber Equipment Program, the Single-Channel Ground and Airborne Radio System, and the Automated Frequency Engineering System. Navy programs supported included AEGIS and the Shipboard Topside Design Program. Joint programs supported included the Joint Tactical Information Distribution System and the Combat Identification System.

(2) (U) FY 1987 Program:

(a) (U) DOD Frequency Management and Engineering Support System: ECAC will complete Phase II of the Frequency Management and Engineering Improvement Plan, upgrading the Services frequency management equipment/software to enable autonomous operation in the event of a disconnect from the Center. ECAC expects to handle over 150,000 frequency

transactions during the year. The second tier of the Space Systems Data Base for non-geostationary space systems will be completed. The Center's Equipment Characteristics File will be converted to the Sperry Data Base Management System 1100, providing the flexibility to handle data concerning complex, multi-functional, communications-electronics (C-E) systems.

(b) (U) Joint Operations Planning: ECAC will evaluate ten major Joint Chiefs of Staff (JCS) contingency plans and make recommendations concerning frequency resource requirements, joint operations frequency management capabilities, and deconfliction procedures to the JCS. Replacement of the Center's main-frame computer with a Sperry 1100/92SV will be completed. The Center will join the DOD Information System Network by completing the hookup of the PDP 11/84 computer in the Sensitive Compartmented Information Facility. The Tactical Environment Generation System will be converted to utilize video disk technology for the storage and retrieval of map feature information. The Tactical Environment Analysis System will be tested and validated. The procedures for determining the compliance of proposed C-E systems acquisitions with military standards and specifications will be automated to improve productivity. The capability of about 220 proposed systems to operate in their intended environments will be examined for the Military Communications Electronics Board.

(c) (U) DOD EMC Technology Transfer Program: ECAC will provide the US Army Battlefield Electromagnetic Environment Office the software to support the Tactical Environment Generation hardware. Capabilities that the Center has developed in support of the US Army Tactical Frequency Engineering System will be converted to run on the Micro-VAX series of computers. The basic package of electromagnetic compatibility engineering capabilities provided to the US Air Force Frequency Management Office in 1986 will be converted to run on the Micro-VAX systems that will be installed at European Command, Atlantic Command, and Pacific Command Headquarters in conjunction with the DOD Frequency Management and Enginering System software.

(d) (U) Projects: Reimbursed sponsor projects will continue to make up about 70% of the ECAC support effort. Examples of the nearly 200 projects to be supported by ECAC in FY 1987 are the US Marine Corps' AV-8B and V-22 developments, HAVE QUICK Radio development, and the deployment of Global Positioning System (GPS) terminals on various platforms. Air Force projects include the Combat Identification System, Joint Tactical Information Distribution System, F-16, Worldwide Airborne Command Post, North Warning System, Ground-Wave Emergency Network, Single-Channel Ground and Airborne Radio System (SINCGARS), GPS, Milstar, Spacecraft Environment, and Spectrum Management Information System. Army projects/organizations supported include the Mobile Subscriber Equipment Program, Ground Mobile Forces Satellite Program, SINCGARS, US Army Information Systems Command Operational Evaluation Centers (National Training Facility, Combat Maneuver Training Complex, and Light Forces National Training Center), and the Army Defense Electronic Warfare System. Navy projects requiring ECAC support are AEGIS, PHALANX, Shipboard Topside Design, satellite crosslink compatibility for the Strategic Defense Initiative (SDI), and frequency assignment and frequency allocation automation. In addition, ECAC will support the Frequency Assignment System 3 for the North Atlantic Treaty Organization and the Defense Satellite Communication System uplinks and downlinks for the Defense Communications Agency.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request:

(a) (U) DOD Frequency Management and Engineering Support System: ECAC will accomplish Phase III of the Frequency Management and Engineering System Improvement Plan, connecting European Command, Atlantic Command, and Pacific Command elements of the system. This improvement will give these three unified commands a computer-aided frequency management and engineering capability that can operate autonomously. The Center will process about 170,000 frequency assignment transactions in FY 1988.

(b) (U) Joint Operations Planning: Twenty major Joint Chiefs of Staff (JCS) contingency plans will be evaluated and recommendations concerning frequency resource requirements, joint operations frequency management capabilities and deconfliction procedures will be provided to the JCS. The Tactical Environment Analysis System will go operational. The capability to address electromagnetic compatability (EMC) problems with respect to millimeter wave and electro-optic systems will become fully operational. A capability will be developed and implemented to provide Military Communications Electronics Board (MCEB) members and Service Frequency Management Offices with remote access to the status of Frequency Allocations and Frequency Allocation Requests concerning communications-electronics systems in the experimental, developmental and operational phases of their life cycles. The analysis of the capability of about 200 proposed communications-electronics equipment to operate in their intended environment will be completed for the MCEB.

(c) (U) DOD EMC Technology Transfer Program: EMC engineering analysis capabilities ECAC has made available to the field on the Hewlett-Packard 41C series of desktop calculators will be reprogrammed to operate on Zenith, IBM, and Wang personal computers in the field. An initial operating capability to assist European Command, Atlantic Command, and Pacific Command elements in the more efficient management of available frequency resources to support ultra-high-frequency air-ground-air communication requirements will be installed on selected Micro-VAX II and III computers in the DOD Frequency Management and Engineering System. ECAC will also give field units having access to the DOD Frequency Management and Engineering System an initial operating capability to employ high-frequency (HF) pooling techniques to improve the frequency supportability of HF communication requirements.

(d) (U) Projects: ECAC will continue EMC support to the Army on Mobile Subscriber Equipment, US Army Information Systems Command Training Centers, Single-Channel Ground and Airborne Radio System, and the Army Air Defense Artillery Threat Simulator. Support to Army SDI efforts will begin. Air Force support will continue on Combat Identification System, Joint Tactical Information Distribution System, F-16, Worldwide Airborne Command Post, North Warning System, Global Positioning System (GPS), Milstar, Spacecraft Environment, and Spectrum Management Information System. Marine Corps EMC efforts will be supported in the V-22 development, improved HAVE QUICK employment, and further GPS employment. Support to the Navy on AEGIS, PHALANX, SDI satellite crosslink, Shipboard Topside Design, and frequency allocation/assignment will continue. Support to the North Atlantic Treaty Organization for the Frequency Assignment System 3 and to the Defense Communications Agency for the Defense Satellite Communication System uplinks and downlinks will also continue.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request:

(a) (U) DOD Frequency Management and Engineering Support System: Phase IV, System Enhancement Phase, based upon requirements validated by the Joint Chiefs of Staff (JCS), will be implemented.

(b) (U) Joint Operations Planning: All revised JCS contingency plans available to the Center will be reevaluated. Five representative European Command contingency plans will be evaluated for the first time.

(c) (U) DOD EMC Technology Transfer Program: Terrain-dependent radar and communication system coverage analysis capabilities will be transferred to JCS-designated operational organizations.

(d) (U) Projects: The reimbursed sponsor program will continue to support the Strategic Defense Initiative, Joint Tactical Information Distribution System, Combat Identification System, Ground Wave Emergency Network, Single-Channel Ground and Airborne Radio System, Milstar, etc. New projects requested by the Services will be initiated.

(5) (U) Program to Completion: The requirement for ECAC to support EMC design, analysis, and planning for the Department of Defense is a continuing one. To meet this requirement, ECAC must continue to update and maintain its existing data bases and analytical techniques, while developing new ones to accommodate advancing technology. In addition, ECAC must respond to an estimated 200 requests for analytical support each year, as well as approximately 7000 requests for data base outputs.

C. (U) Major Milestones: Not Applicable.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 33401F
DOD Mission Area: 380 - Communications Security (COMSEC)

Title: Communications Security
Budget Activity: 5 - Intelligence and Communications

1. RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		[			]	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Air Force Research and Development (R&D) portion of the overall Department of Defense (DOD) COMSEC program addresses problems encountered in adapting general purpose cryptographic equipment for use in new Air Force communications systems. The efforts are primarily directed at insuring that all systems being developed by the Air Force meet current national communication security requirements. The program develops ancillary systems such as voice digitizers, COMSEC equipment adapter units, and, with National Security Agency (NSA) development authority, integrated COMSEC systems to meet specific Air Force Command, Control, Communication, and Intelligence (C^3I) requirements.

3. COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	[	]	N/A	Continuing	N/A

EXPLANATION: (U) FY 1988 shows a net increase as funds were reduced for lower inflation and profit policy estimate and added for work in computer security development. This work, originally in Program Element (PE) 38610F, Information Management Automation Program, is being transferred to PE 64740F, Computer Resource Technology, Project 2239, Computer Security Technology.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: The NSA is the overall manager of communications security equipment research and development under the policy guidance of the Assistant Secretary of Defense C^3I. The Services perform efforts under common Program Element #33401. The Air Force Electronic Security Command (ESC) performs COMSEC testing on equipment proposed for operational use in the USAF and also recommends the application of cryptographic equipment to operational commands.

6. (U) WORK PERFORMED BY: All research and development tasks under this program are managed through the Rome Air Development Center (RADC) of the Air Force Systems Command (AFSC), Electronic System Division (ESD), Hanscom AFB, MA. Contractors are: Lincoln Laboratory, Bedford, MA. (digital speech research); Arcon Corp., Bedford, MA. (math analysis and software development for in-house activities); and Massachusetts Institute of Technology, Boston, MA. Additional research and development (R&D) is accomplished in-house and through co-sponsorship of programs with National

Security Agency, Naval Ocean Systems Center, National Bureau of Standards and the Department of Transportation Research Center.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 33401F, Communications Security.

A. (U) Project Description: The project implements specific R&D task requirements and schedules using in-house resources supplemented by development contracts. Products are transitioned to Electronic Security Command (ESC), Air Force Systems Command (AFSC), Electronics Systems Division (ESD), and National Security Agency (NSA). Tasks within this project are: 01, TEMPEST R&D; 02, COMSEC Technology; 03, Secure Voice. The TEMPEST task directs improving quality of TEMPEST testing to handle an increasing workload with new threat phenomena. The COMSEC task consists of research in use of fiber optic communication and developing a modular COMSEC architecture to integrate all electronic/electrical/control functions in an aircraft. Work in the Secure Voice task consists of developing robust, interoperable digital speech systems with increased intelligibility and quality.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: In the TEMPEST task, all resources were used to find ways to reduce compromising emanations in systems employing embedded COMSEC. A broad-band antenna which gives a new capability to detect impulse-type signals and a fiber optic electromagnetic antenna (FOEMA) were developed and tested. These devices will be part of a development effort to build an automated TEMPEST analysis system which will yield better, faster results at reduced manpower levels. In the Secure Voice task, a technique was developed which enables high-quality encrypted voice data to be transmitted at twice the rate previously possible. This capability will enhance the STU-III, a new secure telephone system now being fielded. Advanced research continued on the real-time implementation of new speech digitizing algorithms which will be the foundation for the next generation secure voice systems.

(2) (U) FY 1987 Program: As part of the TEMPEST task, work on signal processing techniques will continue, using the broad-band antenna and FOEMA developed in 1986. TEMPEST power-line conduction and emanations phenomena will be researched. COMSEC architectures will be analyzed for application to an integrated avionics system. A capability to conduct speech quality testing for secure voice systems will be developed. Research on speech digitizing algorithms for secure voice systems for the year 2000 and beyond will continue. Specifications will be prepared for enhancing the STU-III system with a digital conferencing capability.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Full-scale development will begin on an automated TEMPEST analysis system based on the research done in previous years. This system will permit testing of equipment for which no test capability presently exists, as well as appreciably reducing the time and manpower needed to conduct these tests. Work will begin on techniques for simultaneous control of multiple embedded COMSEC devices in command, control, and communication (C^3) networks such as the avionics equipment netted together on an aircraft. Advanced development of the next generation secure voice system will be contracted for based on the research performed

in the labs previously. This system will improve the intelligibility of secure voice systems operating at different transmission rates. In-house, a capability to measure the effect of accented and foreign language intelligibility in secure voice systems will be developed. A digital conferencing bridge will be developed by contract for the Secure Telephone Unit (STU-III), giving a conference call capability to this new system.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Development and testing of the automated TEMPEST analysis system and the secure conferencing bridge for the STU-III will be completed. Advanced development of the next generation secure voice system will also be finished. Work will begin on a very high speed encryption system for video and graphics data, based on new technologies in data error control and security.

(5) (U) Program to Completion: This is a continuing program consisting of directed tasks in advanced TEMPEST, COMSEC and secure voice research and development to insure Air Force fielded systems are capable of countering exploitation efforts.

C. (U) Major Milestones:

		Milestones	Date
(1)	(U)	Secure Voice Digital Translation Demo	3rd Qtr FY 1987
(2)	(U)	Automated TEMPEST Optical Correlation Demo	4th Qtr FY 1987
(3)	(U)	Contract for Automated TEMPEST Analysis System	1st Qtr FY 1988
(4)	(U)	Contract for Advanced Development on Next Generation Secure Voice System	1st Qtr FY 1988
(5)	(U)	Contract for Secure Digital Conferencing Bridge	1st Qtr FY 1988
(6)	(U)	Developmental and Operational Tests of the Secure Digital Conferencing Bridge.	3rd Qtr FY 1989
(7)	(U)	Automated TEMPEST Analysis System Complete	3rd Qtr FY 1989
(8)	(U)	Complete Development and Test and Evaluation of Next Generation Secure Voice System	1st Qtr FY 1990

8. (U) PROJECTS OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 35114F Title: Traffic Control/Approach/Landing Systems (TRACALS)
DOD Mission Area: 357 - Navigation and Position Fixing Budget Activity: 5 - Intelligence & Communications

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		17,060	17,257	12,095	25,139	Continuing	N/A
2026	System Support	280	289	343	445	Continuing	N/A
2759	Mobile Microwave Landing System (MMLS)	1,300	439	10,430	13,094	9,200	36,263
2839	Next Generation Air Traffic Control System	500	0	0	0	TBD	TBD
2966	New Mobile Rapcon	6,237	5,600	0	TBD	TBD	TBD
2967	Air Traffic Control Survivability	400	5,193	0	0	10,407	16,000
3042	BAMBOO TREE	200	400	400	400	Continuing	N/A
3329	Precision Tactical Approach Guidance	1,640	0	0	0	TBD	TBD
3587	MLS Avionics	6,503	5,336	922	11,200	42,029	71,287

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides the Air Force with the air traffic control and landing equipment required for safe, efficient, worldwide, all weather flying operations. The mission need is to provide take-off, en-route and landing guidance and surveillance in order to meet wartime sortie requirements. In peacetime, the need is to support training, logistics and other operational flying with maximum safety. Some of these programs are not on contract, therefore, contractor estimates are not available for all of them.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	23,913	18,575	5,098	N/A	Continuing	N/A
Aircraft Procurement	0	0	11,500	N/A	Continuing	N/A
Other Procurement	4,109	4,710	22,444	N/A	Continuing	N/A

EXPLANATION: (U) FY 1986 RDT&E was reduced $1.3 Million by Gramm-Rudman-Hollings. $5,523 reprogrammed to other Program Elements to support unfunded requirements. Other procurement funds in FY 1986 and FY 1988 were reduced by $4.1 Million and $13.6 Million respectively by termination of the Air Traffic Control (ATC) Survivability program by the Air Force. FY 1987 RDT&E was reduced $1.3 million to reflect Congressional inflation, profit policy, consultant

and fuel adjustments. In FY 1988 RDT&E funds $4.4 million for Survivability and Next Generation were deleted, however, overall RDT&E increased because of restructuring of the MLS program. The FY 1988 Aircraft Procurement funds ($11.5 Million) were used as a source for the FY 1988 MLS RDT&E funds. The MLS restructuring, which was caused by FY 1987 funding reductions, resulted in a one year delay to the Mobile MLS program and a two year delay the Military Avionics development.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Aircraft Procurement	0	0	0	9,200	672,470	681,670
(Various program elements):						
3587 MLS Avionics						
Funds[1]	0	0	0	9,200	672,470	681,670
Quantities						
Commercial Receiver	0	0	0	160	1,230	2,600
Military Standard Receiver	0	0	0	0	7,578	7,700
Operations and Maintenance	0	0	0	0	285,000	285,000
3587 MLS Avionics						
Funds	0	0	0	0	285,000	285,000
Avionics Installation (Qty)	0	0	0	0	10,300	10,300
Other Procurement:	0	0	1,100	740	272,700	272,700
2759 Mobile MLS						
Funds	0	0	0	0	58,700	58,700
Quantities	0	0	0	0	82	82
3042 Bamboo Tree						
Funds	0	0	1,100	740	N/A	N/A
Quantities	0	0	TBD	TBD	N/A	N/A
2966 Rapidly Deployable ATC						
Funds	0	0	0	TBD	190,000	190,000
Quantities						
Radar/Operation Center	0	0	0	0	18/18	18/18
2967 ATC Survivability						
Funds	0	0	0	0	24,000	24,000
Quantities	0	0	0	0	19/19	19/19

5. (U) RELATED ACTIVITIES: The Microwave Landing System (MLS) is a tri-Service program in which the Air Force is lead. The Air Force will consolidate DOD fixed base MLS requirements and acquire equipment concurrently with the Federal Aviation Administration (FAA). DOD will also develop a Mobile MLS (MMLS) for unique military applications. The Mobile MLS development will take advantage of the FAA fixed base design and the technology obtained from the Army's Joint Tactical MLS engineering development effort. The Global Positioning System (GPS) (PE 35164F) will be investigated as an alternative to precision distance measuring equipment for MLS avionics installation. If GPS can be used for this function, considerable savings in avionics acquisition costs will be realized. The New Mobile Radar (NMR), surveillance radar subsystem is being procured jointly on the Marine Air Traffic Control And Landing System (MATCALS) contract. The Air Force has an option for 18 systems. The operation subsystem will use MATCALS as a basis for competitive procurement.

6. (U) WORK PERFORMED BY: Air Force Systems Command Electronic Systems Division, Hanscom AFB, MA, manages the overall TRACALS effort. ARINC Research Corporation, Annapolis, MD provides cost data for System Support (Project 2026) and also for the MLS (Projects 2759/3578); Mitre Corporation, Bedford, MA provides system support (Project 2026) and MLS technical support (Projects 2759/3578). Sperry Corporation will build the New Mobile Radar, radar subsystem (Project 2966).

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 2966, Rapidly Deployable Air Traffic Control System. The New Mobile Rapcon is the planned replacement for existing 1950 technology mobile systems. In FY 1986, the number of units was reduced from 25 to 18. Additionally, the precision portion was deleted as the Mobile Microwave Landing System is the planned replacement for for 1-18 radar systems. Funds currently exist for a first article system. In FY 1987, preparation for competitive procurement will begin for the operations shelter using Marine Air Traffic Control And Landing Systems (MATCALS) development to the extent possible. An operational shelter would be procured and integrated with the radar in 1988-1989 Production would then follow. Prior year funding was deleted pending restructure of the program for a New Mobile Rapcon. These systems not only provide wartime restoral but are used in peacetime by Air National Guard Units, support exercises, deployments, and emergency mission support. The system will give increased capability in radar tracking to support higher density traffic, Electronic Counter Countermeasures, siting and Chemical Biological Radiation protection. The radar subsystem contract was awarded by the Navy to Sperry Corporation in July 1986.

B. (U) Project: 2026, System Support. This project provides planning support to all Traffic Control and Landing System acquisition projects managed by Air Force Systems Command including several joint efforts with the Federal Aviation Administration (FAA) which have no Air Force RDT&E funding. The project funds preprogram costing and definition efforts. FY 1986 efforts further define requirements for the Rapidly Deployable Air Traffic Control System and MATCALS. In FY 1987 and FY 1988, work will define how Air Force traffic control facilities in the United States will interface with FAA National Airspace System Plan initiatives. The work is essential to keep pace with new developments. New positioning/navigation aids such as Global Positioning System and the emerging FAA changes in the Air Traffic Control (ATC) structure require support definition. The effort will help assure Air Force operational capability in the ATC environment. This is a continuing program to keep pace with the civil airspace authority modernization.

C. (U) Project: 3042, Bamboo Tree. Bamboo Tree is the nickname for Air Force efforts to assure that the United States can maintain air access to fly the Berlin corridors. The Berlin radar automation program is complete. Integration with existing communication capabilities and problem resolution will be supported. This project has been programmed to provide continuing support to the Bamboo Tree mission. A continued effort is essential to maintain capabilities in the Berlin environment. Efforts will be directed toward defining an integrated air/ground communications capability. No new radios will be developed but the communication complex at Templehof Central Airport will require redesign to integrate the new families of radios developed under other programs into the complex.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2759, Mobile Microwave Landing System (MMLS).

A. (U) Project Description: The Mobile Microwave Landing System (MMLS) acquisition is part of a twenty year program to transition Air Force operations from use of Precision Approach Radar and the Instrument Landing System to the international standard Microwave Landing System (MLS) for all tactical and fixed base precision landing operations. This will require acquisition of both ground and airborne equipment. Acquisition will be paced to civil sector plans with most procurement and installation costs incurred in the 1988 to 1998 time frame. The International Civil Aviation Organization established MLS transition date is 1998. Transition to MLS provides for continued interoperability with civil landing systems, and NATO which through Standardization Agreement 4184 has also agreed to transition to Microwave Landing System (MLS) by 1998. The Mobile Microwave Landing System (MMLS) will be a modular, highly mobile system, weighing a maximum of 1000 pounds. The MMLS acquisition will be conducted in parallel with the second Federal Aviation Administration (FAA) multi-year fixed base MLS procurement which includes options for DOD fixed base MLS. Bidders will be able to propose on the MMLS, the fixed base MLS or both. If they propose on both systems, proposals will include an analysis of savings resulting from common hardware, software etc., should they win both contracts. The MMLS will specifically replace the mobile precision approach radar which is presently used for combat restoral and emergency mission support, and provides Military Airlift Command Combat Control teams with a new capability for special operation missions at austere airstrips/landing zones. The overall MLS program includes development and procurement of the MMLS, procurement of the fixed base MLS which was developed by the FAA, and development and procurement of MLS avionics. The avionics effort is described in paragraph nine project 3587.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: The FY 1986 effort concentrated on the MMLS Request for Proposal preparation.

(2) (U) FY 1987 Program: In FY 1987, the MMLS ground equipment request for proposal will be released. This effort will be accomplished in parallel with the FAA Fixed Base MLS (FBMLS) source selection. DOD requirements for FBMLS will be included in the FAA contract.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: In FY 1988, the MMLS full scale

development contract will be awarded and fabrication of the MMLS prototype ground equipment will begin. The MMLS cost estimate is based on an Air Force Systems Command Category IV Planning Cost estimate. Acquisition strategy includes a competitive full scale development with fixed price production options.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: In FY 1989 fabrication of MMLS equipment will be completed. Development Test and Evaluation and Initial Operational Test and Evaluation will be conducted. The MMLS cost estimate is based on an Air Force Systems Command Category IV Planning Cost estimate. Acquisition strategy includes a competitive full scale development with fixed price production options.

(5) (U) Program to Completion: Through the year 2000 acquisition and installation of MLS avionics and ground equipment will continue. Eventually over 10,000 Air Force aircraft will be equipped with commercial or standard military Microwave Landing System (MLS) avionics and over 300 fixed/mobile ground systems will be deployed.

C. (U) Major Milestones:

Milestones		Dates
(1) (U) Mobile Microwave Landing System MLS (MMLS) Request for Proposal Release	*(3rd Quarter FY 1986)	March 1987
(2) (U) Fixed Base MLS (FBMLS) Request for Proposal Release		March 1987
(3) (U) MMLS Contract Award	*(1st Quarter FY 1987)	1st Quarter FY 1988
(4) (U) FBMLS Contract Award		1st Quarter FY 1988
(5) (U) MMLS DT&E/IOT&E Complete Development Test and Evaluation (DT&E) Initial Operational Test and Evaluation (IOT&E)		2nd Quarter FY 1990
(6) (U) MMLS Production Decision	*(3rd Quarter FY 1989)	3rd Quarter FY 1990
(7) (U) FBMLS Initial Operating Capability (IOC)		1st Quarter FY 1991
(8) (U) MMLS IOC	*(3rd Quarter FY 1990)	4th Quarter FY 1991
(9) (U) FBMLS Ground Equipment Installation Complete		4th Quarter FY 1998

* Date presented in FY 1987 Descriptive Summary.

(U) Explanation of Milestone Changes

(1) (U) MMLS Request for Proposal Release slipped to align with Federal Aviation Administration (FAA) schedule for concurrent acquisition of fixed and MMLS equipment.
(3) (U) MMLS contract award slipped to align with FAA schedule for concurrent acquisition of fixed and MMLS equipment.
(6) (U) MMLS DT&E/IOT&E complete slipped to align with FAA schedule for concurrent acquisition of fixed and MMLS equipment.

(8) (U) MMLS Initial Operating Capability slipped six months to align with FAA schedule for concurrent acquisition of fixed and MMLS equipment.

9. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3587 Microwave Landing System Avionics.

A. (U) Project Description: Under this project commercial MLS avionics will be modified and tested as necessary for integration and installation into cargo, tanker, training, bomber and operational support aircraft. Modifications will include a 1553B data bus capability, an off-set approach algorithm calculation and course softening for use with a collocated ground station. Also under this project a Military Microwave Landing System (MLS)/Instrument Landing System (ILS) receiver will be developed for integration and installation on high performance aircraft. The overall MLS avionics architecture was reviewed by Office of the Secretary of Defense in Dec 1986 when OSD was briefed on the results of the MLS avionics architecture study initiated in FY 1985. The study addresses Microwave Landing System (MLS) receiver and ranging alternatives, antenna design and placement, aircraft integration, reliability/maintainability, and logistics support. In order to reduce airframe down time and integration costs, MLS installations will be accomplished under the programmed depot modification schedule and, when possible in conjunction with the Global Positioning System (GPS) modification schedule. During the transition period from the Instrument Landing System (ILS) to MLS, both systems will be maintained on the ground and in the aircraft. Once all aircraft are equipped with MLS, the ILS and Precision Approach Radar ground equipment and stand alone ILS avionics will be phased out.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: The FY 1986 effort centered on preparation of the Commercial MLS Avionics request for proposal and completion of the MLS avionics architecture study. The study addressed various fleet-wide MLS strategies, the operational capabilities associated with each strategy, logistics support, and life cycle cost for each alternative.

(2) (U) FY 1987 Program: In FY 1987, the results of the avionics architecture study will be provided to the Office of the Secretary of Defense for review and approval and the contract for the modified Commercial Avionics will be awarded. A Military MLS Avionics high reliability technology demonstration contract will also be awarded.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: In FY 1988, fabrication and test and evaluation of the modified Commercial Avionics will be completed and upon completion of the Military Avionics high reliability technology demonstration, the request for proposal for the full scale development of the Military Avionics will be released. Acquisition strategy is based on a competitive full scale development with fixed price production options. Cost estimates are based on an Air Force Systems Command Category IV Planning cost estimate.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: In FY 1989, the Military Avionics full scale development contract will be awarded and the initial production option for modified Commercial Avionics will be

exercised. The Military Avionics acquisition strategy will be based on a competitive full scale development with fixed price production options. Avionics cost are based on Category IV budgetary data.

(5) (U) Program to Completion: The remaining effort will consist of test and evaluation of the Military Avionics and integration and installation of Commercial Avionics and Military Avionics into over 10,000 Air Force aircraft. This effort will take 12-15 years and is programmed for completion by FY 1998-2000.

C. (U) Major Milestones:

	Milestones	Dates
(1)	(U) Commercial Avionics Request for Proposal Release	December 1986
(2)	(U) OSD Microwave Landing System (MLS) Avionics Architecture Review Office of the Secretary of Defense (OSD)	December 1986
(3)	(U) Military Avionics Technology Demo RFP Release	January 1987
(4)	(U) Military Avionics Technology Demo Contract Award	March 1987
(5)	(U) Commercial Avionics Contract Award	May 1987
(6)	(U) Military Avionics Request for Proposal Release	2nd Quarter FY 1988
(7)	(U) Commercial Avionics DT&E/IOT&E Complete Development Test and Evaluation (DT&E) Initial Operational Test and Evaluation (IOT&E)	4th Quarter FY 1988
(8)	(U) Military Avionics Contract Award	1st Quarter FY 1989
(9)	(U) Commercial Avionics Production Decision	1st Quarter FY 1989
(10)	(U) Commercial Avionics Initial Operating Capability (IOC)	1st Quarter FY 1991
(11)	(U) Military Avionics DT&E/IOT&E Complete	4th Quarter FY 1991
(12)	(U) Military Avionics Production Decision	1st Quarter FY 1992
(13)	(U) Military Avionics IOC	1st Quarter FY 1993
(14)	(U) Avionics Installations Complete (Goal)	4th Quarter FY 1998

10. (U) Cooperative Agreements: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 35164F
DOD Mission Area: 357 - Navigation and Position Fixing
Title: Navstar Global Positioning System (User Equipment)
Budget Activity: 5 - Intelligence and Communications

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		25,836	28,972	45,801	61,697	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element funds Research and Development to integrate Navstar Global Positioning System (GPS) user equipment into approximately 11,000 Air Force airborne and ground platforms. It also funds production and installation of GPS equipment and their associated support. Military forces need precise location data to enhance command and control and to engage in strategic and tactical warfare. A global, common grid positioning and navigation system is required to increase both accuracy and availability of current weapon systems, especially at night and in adverse weather. GPS improves our strategic target mapping capability, the probability of target acquisition, flexible routing, low-level ingress/egress, and accuracy of delivered weapons. These features, along with a capability for highly accurate passive operations, enhance the force effectiveness and survivability of many U.S. weapon systems. GPS satellites will also carry the Nuclear Detonation (NUDET) Detection System (formerly known as the Integrated Operational NUDET Detection System) as an additional payload to detect and locate nuclear detonations. The GPS Mission Element Need Statement was revalidated by the Secretary of Defense at Milestone II in May 1979.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	27,960	45,024	52,650	N/A	Continuing	N/A
Aircraft Procurement	52,100	77,900	155,500	N/A	Continuing	N/A
Other Procurement	3,828	9,260	20,995	N/A	Continuing	N/A

EXPLANATION: (U) FY 1986 RDT&E and Aircraft Procurement funding reflects adjustments for actual obligations and a reprogramming of Aircraft Procurement funds in response to aircraft modification schedule changes. FY 1986 Other Procurement funding reflects reprogramming to restore funding in response to a Congressional reduction and preserve the FY 1986 Low Rate Initial Production option. FY 1987 RDT&E and Other Procurement funding was reduced by Congressional action. FY 1988 RDT&E funding was reduced by the Air Force to properly integrate funding with program requirements. Procurement funding was adjusted consistent with Air Force adjustments to aircraft modification line schedules and to accommodate the requirements of the Low-Rate Initial Production decision (Milestone IIIA) obtained from the Joint Requirements and Management Board in June 1986.

Program Element: 35164F | Title: Navstar Global Positioning System (User Equipment)
DOD Mission Area: 357 - Navigation and Position Fixing | Budget Activity: 5 - Intelligence and Communications

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Aircraft Procurement:						
Funds	49,051	73,971	148,188	163,592	Continuing	N/A
Quantities (Receivers)	(70)	(212)	(356)	(452)		
Other Procurement:						
Funds	9,264	10,890	13,960	20,972	Continuing	N/A
Quantities (Manpacks)	(87)	(121)	(188)	(424)		

5. (U) RELATED ACTIVITIES: The Global Positioning System (GPS) development and operational implementation is a joint program. Supporting activities of the Army, Navy, Marine Corps, Defense Mapping Agency, Department of Transportation and North Atlantic Treaty Organization (NATO) are coordinated through the Joint Program Office. Use of the GPS to provide guidance corrections for tactical missiles is being separately explored under PE 63601F, Conventional Weapon Technology. Examination of advanced anti-jamming technology is conducted under PE 63202F, Advanced Avionics for Aircraft. GPS also supports the Navy Fleet Ballistic Missile Programs (PE 11221N, Fleet Ballistic Missile Systems) by providing test range positioning instrumentation. The NATO GPS project is a cooperative venture between the United States and nine NATO nations. This project provides information to these nations to assist them in making decisions about adopting the system for their military forces. Full Scale Development of user equipment was funded by all services under PE 64777N and PE 64778A/F, Navstar GPS, for the Navy, Army and Air Force, respectively. The Air Force funded initial satellite development and ground control segment development/deployment in PE 64778F and production and operation in PE 35165F. The Navy funds the development of clock technology used by both the satellite and control segment in PE 64777N. Integration of user equipment into Army and Navy platforms (subsurface, surface and airborne) is funded in PE 64778A and PE 64777N, respectively. Procurement funding for Army and Navy equipments is in PE 35164A/N and specific aircraft and ship program elements. The Nuclear Detonation (NUDET) Detection System (NDS) payload was flown on satellites 8, 9, 10 and 11. NDS will also be flown on all production satellites. PEs 31357F and 12433F, Nuclear Detonation Detection System, fund NDS payloads. Expendable launch services (Delta II) are funded under PE 35119F, Space Boosters. Space Shuttle launches and Payload Assist Module Delta Class II (PAM-DII) upper stages are funded under PE 35171F, Space Launch Support. The Consolidated Space Operations Center, which hosts the operational GPS Master Control Station, is funded under PE 35130F.

6. (U) WORK PERFORMED BY: The Joint Program Office is located at the Air Force Systems Command's Space Division, Los Angeles AFS, CA. User equipment is produced by Rockwell International, Collins Government Avionics Division, Cedar Rapids, IA. Aerospace Corp., El Segundo, CA, provides technical and engineering support. Intermetrics,

Cambridge, MA is the user equipment software independent verification/validation contractor. The Naval Air Development Center, Warminster, PA; the Naval Avionics Center, Indianapolis, IN; and the Army Avionics Research and Development Activity, Ft Monmouth, NJ, are providing technical and validation support to the program office for joint service user equipment development and production.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 35164F, Navstar Global Positioning System (GPS) (User Equipment)

A. (U) Project Description: The GPS is a space-based radio positioning and navigation system designed to provide worldwide, all-weather, three-dimensional position (16 meter Spherical Error Probable), velocity (0.1 meter/sec) and precise time (within 0.1 microsecond). GPS provides a common navigation grid for land, air and sea units for coordinated operations. GPS consists of three segments. The space segment (funded in PE 35165F) produces the worldwide navigation signals. It consists of an 18-satellite constellation plus three on-orbit spares. The control segment (also funded in PE 35165F) consists of five Monitor Stations and three ground antennas (located around the world) and a master control station (MCS), which is located in the Consolidated Space Operations Center. The Monitor Stations measure satellite performance parameters which are evaluated by the MCS and then corrected as necessary using the ground antennas. The user segment consists of the electronic equipment and interfaces necessary to receive and process GPS satellite signals into position, velocity, and time data for various military users. This project develops the capability to integrate GPS user equipment into Air Force airborne and ground systems.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: RDT&E was used to initiate user equipment integration efforts for the B-52G; E-3A; F-111 family, and RC-135. These efforts included GPS/vehicle integration planning, software development/modification, interface control working group activities, system integration lab testing, prototypes, technical support and maintenance. The development of a standard GPS equipment interface continued.

(2) (U) FY 1987 Program: Development of the GPS standard interface will be completed. Development of software modifications for the B-52G, E-3A and F-111 family of aircraft will continue. GPS integration planning/software development activities for the B-52H, F-15 family, KC-10, F-16C/D, A-7D and C-130 family will be initiated. Development of depot training equipment and simulators will be initiated.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Development of integration software for the F-111 A/E, B-52G and RC-135 will be completed and other previously initiated efforts will continue. Integration efforts will begin for the F-16 A/B, F-4 family, B-1B, A-10, KC-135, UH-60 and E-4. Development of depot training equipment and simulators continues. This line also funds follow-on user equipment testing in preparation for the start of full rate production in FY 1989. Cost estimates for the standard interface are based on negotiated contracts

and are category I, comprehensive, estimates. Cost for user equipment integration including software modifications are based on preliminary Modification Proposal Analyses conducted by Air Force Logistics Command (AFLC) and are category II, mature, estimates. Integration study estimates are based on preliminary AFLC (category IV) planning estimates.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Development of integration software for initial C-130 family aircraft will be completed and other ongoing integration efforts will continue. Integration preparations will be initiated for the Advanced Tactical Fighter, additional C-130 family aircraft, WC-135 and EC-135. Development of depot training equipment and simulators continues. Follow-on testing will be completed in preparation for a full-rate production decision in FY 1989. The same cost estimate categories apply as in FY 1988.

(5) (U) Program to Completion: This is a continuing program. Effort will continue beyond the year 2000 to integrate GPS into all United States Air Force (USAF) aircraft to support world-wide navigation in lieu of other proliferated radio navigation systems.

C. (U) Major Milestones:

		Milestones		Dates
(1)	(U)	Defense Systems Acquisition Review Council (DSARC) II		May 1979
(2)	(U)	Begin Satellite Production (PE 35165F)		September 1982
(3)	(U)	Begin User Avionics Initial Operational Test and Evaluation (PE 64778F)		November 1984
(4)	(U)	Joint Requirements and Management Board (JRMB) IIIA (PE 35164F)		June 1986
(5)	(U)	Begin User Avionics Limited Production (PE 35164F)		August 1986
(6)	(U)	JRMB IIIB (PE 35164F)		FY 1989
(7)	(U)	Launch First Operational Satellite (PE 35165F)	*(2nd Quarter FY 1987)	1st Quarter FY 1989**
(8)	(U)	Achieve Worldwide 2-D Capability (PE 35165F)	*(4th Quarter FY 1987)	4th Quarter FY 1989**
(9)	(U)	Achieve Worldwide 3-D Capability (PE 35165F)	*(1st Quarter FY 1989)	4th Quarter FY 1990**

* Date presented in FY 1987 Descriptive Summary
** Dates are based on current version of DOD launch manifest.

(U) Explanation of Milestone Changes:

(7) (U) Milestone nomenclature changed from FY 1987 Descriptive Summary to reflect DOD launch strategy (Shuttle/Delta II). Milestone delay caused by Shuttle schedule changes.
(8) (U) Delay caused by Shuttle schedule changes.
(9) (U) Delay caused by Shuttle schedule changes.

9. (U) COOPERATIVE AGREEMENTS: In April, 1978, a Memorandum of Understanding (MOU) was signed with nine NATO allies and with Australia to permit NATO and Australian participation in the development of GPS user equipment. The MOU created an international team at the US Joint Program Office (JPO) in California, with each nation providing representatives to the JPO. Nations involved include Britain, Norway, the Netherlands, Italy, Germany, France, Denmark, Canada, Belgium and Australia. Allied personnel are fully integrated into the user equipment, program management, and operational applications functional areas of the JPO. They have supported Navstar activities during user equipment Full-Scale Engineering Development and will continue their roles as the program progresses into Low-Rate Initial Production leading to the full-rate production decision planned in FY 1989.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 35165F
DOD Mission Area: 357 - Navigation and Position Fixing

Title: Navstar Global Positioning System (GPS) (Space/Ground Segments)
Budget Activity: 5-Intelligence and Communications

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		45,087	36,305	26,309	61,257	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program element provides for the Navstar GPS satellite program. This includes: satellite development, procurement, deployment; operation of the ground control segment; preplanned product improvements to improve survivability of both the space and control segments; and R&D efforts to support deployment of the entire GPS system. Military forces need to know precise location data to enhance command and control end to engage in strategic and tactical warfare. A global, common grid positioning and navigation system is required to increase both accuracy and availability of current weapon systems especially at night and in adverse weather. GPS improves our strategic target mapping capability, the probability of target acquisition, low-level ingress/egress, flexible routing, and the accuracy of delivered weapons. These features, along with a capability for highly accurate passive operations, enhance the force effectiveness and survivability of many U.S. weapon systems. GPS satellites will also carry the Nuclear Detonation (NUDET) Detection System (formerly Integrated Operational NUDET Detection System) as an additional payload to detect and locate nuclear detonations. The GPS Mission Element Need Statement was revalidated by the Secretary of Defense at Milestone II in May 1979.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	44,365	44,362	45,592	N/A	Continuing	N/A
Missile Procurement	197,398	129,665	103,585	N/A	Continuing	N/A
Other Procurement	0	3,925	3,899	N/A	Continuing	N/A

EXPLANATION: (U) The FY 1987 decrease primarily reflects Congressional reductions. Funding changes in FY 1988 reflect a rephased competitive satellite development program supporting the production of GPS replenishment satellites, extended development support for the control segment, and satellite/launch vehicle interface engineering as a result of the 24 month Shuttle standdown.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Missile Procurement:						
Funds (GPS Satellites)	203,398	128,527	92,605	61,217	Continuing	N/A
Quantities (Order/Full Fund)	(0/9)	(0/8)	(0/4)	(0/0)		
Other Procurement:						
Funds		3,925	3,807	0	0	7,800
Quantities				Not Applicable		

5. (U) RELATED ACTIVITIES: The GPS development and operational implementation is a joint program. Supporting activities of the Army, Navy, Marine Corps, Defense Mapping Agency, Department of Transportation and North Atlantic Treaty Organization (NATO) are coordinated through the Joint Program Office. Use of the GPS to provide guidance corrections for tactical missiles is being separately explored under PE 63601F, Conventional Weapons Technology. Investigation of advanced antijamming technology is conducted under PE 63203F, Advanced Avionics for Aircraft. GPS also supports the Navy's Fleet Ballistic Missile Programs (PE 11221N, Fleet Ballistic Missile Systems) by providing test range positioning instrumentation. A NATO contingent provides information to NATO nations to assist in making decisions about adopting the system for their military forces. Full Scale Development of user equipment was funded by all service under PEs 64777N and 64778A/F, Navstar GPS for the Navy, Army and Air Force, respectively. The Air Force funded initial satellite development and ground control segment development/deployment in PE 64778F. The Navy funds the development of clock technology used by both the satellite and control segment in PE 64777N. RDT&E and procurement funds to integrate GPS avionics in Air Force ground and airborne platforms are in PE 35164F, Navstar GPS User Equipment and specific aircraft program elements. Integration of user equipment into Army and Navy platforms (subsurface, surface, and airborne) is funded in PE 64778A and PE 64777N, respectively. Procurement funding for Army and Navy equipment is in PE 35164A/N and specific aircraft and ship program elements. The Nuclear Detonation (NUDET) Detection System (NDS) (formerly known as Integrated Operational NUDET Detection System) payload was flown on Navstars 8, 9, 10 and 11. NDS will also be flown on all production satellites. PEs 31357F and 12433F, Nuclear Detonation Detection System, fund NDS payloads. Expendable launch services (Atlas E/F (used to launch the last development GPS satellite) and the Delta II (Medium Launch Vehicle)) are funded under PE 35119F, Space Boosters. Space Shuttle launches and Payload Assist Module Delta Class II (PAM DII) upper stages are funded in PE 35171F, Space Launch Support. The Consolidated Space Operations Center which hosts the operational GPS Master Control Station, is funded in PE 35130F.

Program Element: 35165F
DOD Mission Area: 357 - Navigation and Position Fixing

Title: Navstar Global Positioning System (GPS) (Space/Ground Segments)
Budget Activity: 5 - Intelligence and Communications

6. (U) WORK PERFORMED BY: The Joint Program Office is located at the Air Force Systems Command's Space Division, Los Angeles AFS, CA. The satellite contractor is Rockwell International Space Operations and Satellite Systems Division, Seal Beach, CA. International Telephone and Telegraph, Nutley, NJ, and Rockwell International/Autonetics Strategic Systems Division, Anaheim, CA, are the subcontractors for the navigation subsystems. Aerospace Corp., El Segundo, CA, provides technical and engineering support. User Equipment will be produced by Rockwell International Collins Government Avionics Div., Cedar Rapids, IA. Operational Control Segment development/deployment is being done by International Business Machines/Federal Systems Div., Gaithersburg, MD.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 35165F, Navstar Global Positioning System (Space/Ground Segments)

A. (U) Project Description: The Navstar GPS is a space-based radio positioning and navigation system designed to provide worldwide, all weather, three-dimensional position (16 meter Spherical Error Probable), velocity (0.1 meter/sec) and precise time (within .1 microsecond). GPS provides a common navigation grid for land, air and sea units for coordinated operations. GPS consists of three segments. The space segment produces the worldwide navigation signals. It consists of the 18 satellite constellation plus several on-orbit spares. The control segment consists of five monitor stations and three ground antennas (located around the world) and a Master Control Station (MCS), which is a tenant in the Consolidated Space Operations Center. The monitor stations measure satellite performance parameters which are evaluated and corrected by the MCS and then forwarded to the satellites by the Ground Antennas. The user segment (funded by PE 35164F) consists of the avionics and interfaces necessary to receive and process GPS satellite signals into position, velocity, and time data for various military users.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: All development efforts initiated under PE 64778F were transferred to this Program Element. The last developmental satellite was launched in Oct 1985. The seven satellite developmental GPS constellation was supported ensuring GPS availability during user equipment and the Navy's Fleet Ballistic Missile Program testing. Qualification and pathfinder (mating a GPS production satellite with an PAM-D II upper stage at Cape Canaveral AFS, FL, the GPS launch site) tests of the preproduction GPS satellite were successfully accomplished. The enginnering effort to make the twelve GPS production satellites compatible with the Shuttle and Delta II began. Full scale development/testing of the GPS operational ground control segment continued. The GPS MCS was successfully moved from Vandenberg AFB, CA to Falcon AFS, CO and was declared operational in April 1986. Limited Developmental Test and Evaluation (DT&E) testing was performed using the GPS development satellites. In addition, the first of several software block changes to the GPS MCS, compatible with the GPS production satellites, was delivered.

Program Element: 35165F
DOD Mission Area: 357 - Navigation and Position Fixing

Title: Navstar Global Positioning System (GPS) (Space/Ground Segments)
Budget Activity: 5 - Intelligence and Communications

(2) (U) FY 1987 Program: Control segment activities supporting the GPS development satellites will continue. Control segment software modifications to accommodate full operation with the GPS production satellites including the Nuclear Detonation (NUDET) Detection System (NDS) electromagnetic pulse sensor will continue. This will also include software rehosting to allow operation on Consolidated Space Operations Center standard IBM 3083 Computers. Navigation data message processing will be expanded to allow GPS navigation for up to 180 days without control segment update. Engineering efforts will continue supporting preparations of the launch of the first GPS production satellite. Efforts will begin on developing second sources for improved key satellite payload boxes. This development activity will become the basis to compete the GPS replenishment satellite development/production effort. GPS/Delta II interface compatiblity and launch support engineering efforts will continue.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Control segment activities supporting the GPS development satellites will continue. Control Segment software development for the GPS production satellites (including the NDS sensor package) will be completed and the operational software will be delivered. Engineering efforts will continue supporting the first launch of a GPS production satellite. GPS/Delta II interface compatibility engineering efforts will continue. The second source effort begun in FY 1987 will conclude. This will then provide the industrial base for the development and procurement of GPS replenishment satellites. Control segment and satellite costs are based on similar previous development efforts and negotiated contracts, and are category II, mature, cost estimates.

(4) (U) FY 1989 Planned Program and Basis for FY 1988 RDT&E Request: Control segment activities supporting the GPS development and production satellites (as they are launched) will continue. System level Developmental Test and Evaluation/Initial Operational Test and Evaluation (DT&E/IOT&E) testing of control segment software will begin as production satellites are launched. The development of the GPS replenishment satellites will begin. Engineering activities supporting the launch of GPS production satellites will continue. The cost category is the same as FY 1988.

(5) (U) Program to Completion: This is a continuing program. Support of the GPS satellite constellation will continue. Deployment of production satellites will continue. Development and deployment of GPS replenishment satellites will continue. System engineering to support the growing community of GPS users will be required.

C. (U) Major Milestones:

	Milestones	Dates
(1)	(U) Defense Systems Acquisition Review Council (DSARC) II	May 1979
(2)	(U) Begin Satellite Production (PE 35165F)	September 1982
(3)	(U) Begin User Avionics Initial Operational Test and Evaluation (IOT&E) (PE 64778F)	November 1984
(4)	(U) DSARC IIIA (PE 35164F)	June 1986
(5)	(U) Begin User Avionics Limited Production (PE 35164F)	August 1986

Program Element: 35165F
DOD Mission Area: 357 - Navigation and Position Fixing

Title: Navstar Global Positioning System (GPS) (Space/Ground Segments)
Budget Activity: 5 - Intelligence and Communication

Milestones	Dates
(6) (U) Launch First Satellite	*(2nd Quarter FY 1987) 1st Quarter FY 1989**
(7) (U) Achieve Worldwide 2-Dimensional Capability	*(1st Quarter FY 1988) 4th Quarter FY 1989**
(8) (U) Achieve Worldwide 3-Dimensional Capability	*(1st Quarter FY 1989) 4th Quarter FY 1990**

* Dates presented in FY 1987 Descriptive Summary.
** Launch dates and GPS capabilities based on the Delta II contractor proposal and current DOD launch manifest.

(U) Explanation of Milestone Changes

(6) (7) (8) (U) First launch of an operational satellite and GPS operational capabilities slipped because of 24 month Shuttle standdown.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63402F — Title: Space Test Program (STP)
DOD Mission Area: 410 - Space Launch and Orbital Support — Budget Activity: 6 - Defense-Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	57,255	49,219	90,197	130,664	Continuing	N/A
2617	Free-Flyer Spacecraft Missions	18,425	24,589	55,168	79,049	Continuing	N/A
2618	Quick Response Shuttle Missions	250	512	1,463	2,497	Continuing	N/A
2619	Teal Ruby Mission	25,243	11,794	11,987	25,276	36,172	278,963
2620	Shuttle Sortie Missions	13,337	12,324	21,579	23,842	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Space Test Program (STP) advances DOD technology by providing spaceflight missions for experiments that demonstrate new space system technologies, concepts, and designs and for experiments that determine space environmental effects on DOD space systems. This tri-Service program provides the only substantial spaceflight capability to perform fly-before-buy demonstrations of advanced technology designs. These experiments are flown based on relevance to existing military requirements and the availability of cost effective means of spaceflight on expendable launch vehicles or Shuttle. The STP is the pathfinder for exploiting the Shuttle as a manned DOD space laboratory to expedite the infusion of new technology into space systems through the use of simpler, incrementally designed, man-aided experiments. The experience gained from this approach will be a key element in fully defining military man's role in space.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	66,690	73,692	83,730	N/A	Continuing	N/A

EXPLANATION: The FY 1986 funding reduction reflects adjustments for Gramm-Rudman-Hollings and Small Business Innovative Research. Congress reduced the FY 1987 appropriation due to STP's significant reliance on Shuttle and the assumed lack of activity during the Shuttle standdown. The FY 1988 budget request was increased to compensate for additional program requirements due to the delay of Shuttle payloads and the increasing need to upgrade existing space systems which support DOD missions.

4. (U) OTHER APPROPRIATIONS FUNDS: Not Applicable

Program Element: 63402F | Title: Space Test Program (STP)
DOD Mission Area: 410 - Space Launch and Orbital Support | Budget Activity: 6 - Defense-Wide Mission Support

5. RELATED ACTIVITIES: Expendable launch vehicles and their corresponding launch support are programmed for by STP and procured through Space Boosters, PE 35119F, with STP appropriated funds. Space Shuttle launch support is provided by Space Shuttle Operations, PE 35171F. Host satellites for STP payloads include the Defense Meteorological Satellite Program, PE 35160F; National Aeronautics and Space Administrations's (NASA) Long Duration Exposure Facility; Navy Transit; NASA's Tracking and Data Relay Satellite; National Oceanic and Atmospheric Administration's (NOAA) Television Infra-Red Observation Satellite and Geosynchronous Operational Environmental Satellite; and classified programs. Payloads are supported by the following: Office of Naval Research; Naval Research Laboratory; Defense Nuclear Agency; Air Force Academy; Naval Post Graduate School; Naval Air Systems Command; Space and Naval Warfare Systems Command; Army Atmospheric Sciences Laboratory; Defense Advanced Research Projects Agency; NASA; Defense Research Sciences, PE 61102F; Geophysics, PE 62101F; Materials, PE 62102F; Aerospace Propulsion PE 62203F; Advanced Weapons, PE 62601F; Cruise Missile Surveillance Technology, PE 63424F; Space Communications, PE 63432F and Memorandum of Agreements (MOAs) exist between the Air Force and NASA's Goddard Space Flight Center and Marshall Space Flight Center, NOAA, Defense Advanced Research Projects Agency, Defense Nuclear Agency, Naval Research Laboratory, the Army's Engineering Topographic Laboratory. MOAs exist with Great Britain, Canada and Australia for participation in the Teal Ruby program.

6. (U) WORK PERFORMED BY: The Air Force Systems Command's Space Division, Los Angeles AFS, CA, is responsible for spaceflight planning, engineering, procurement, and operational aspects required to execute the Space Test Program (STP). Systems engineering support is provided by the Aerospace Corporation, Los Angeles, CA. Current payload integration and/or spacecraft contractors are Rockwell International, Seal Beach, CA (P888, Teal Ruby/P80-1 spacecraft); Lockheed Missiles and Space Company, Sunnyvale, CA (P675, Cryogenic Infrared Radiance Instrumentation for Shuttle (CIRRIS) 1A/Experiment Support System (ESS) spacecraft); through NASA, Ball Aerospace, Boulder CO (P86-1, Combined Release and Radiation Effects Satellite; through Defense Nuclear Agency, John Hopkins University/ Applied Physics Laboratory, Baltimore, MD (P87-1, Polar Beacon Experiment and Auroral Research spacecraft and P86-F, Polar Orbiting Mission); NASA's Goddard Space Flight Center, Greenbelt MD (Spartan experiment carrier) and through NOAA, RCA Astro-Electronics, Princeton, NJ (TIROS host vehicle for three prototype environmental sensors).

7. (U) PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2618, Quick Response Shuttle Missions. This STP project supports the flight of Quick Response Shuttle Payloads (QRSPs). This effort provides simplified integration for QRSPs to determine man's ability to respond to immediate DOD needs. These QRSP experiments maximize near-term flight opportunities on both DOD and NASA Space Transportation System missions. QRSP experiments make use of Shuttle mid/aft-deck lockers. The new Military Man-In-Space program augmented by standard spaceflight hardware will be utilized to meet these unique DOD payload requirements. In FY 1986, two QRSP were flown prior to the Shuttle Challenger accident. Clouds II was a reflight of an Air Weather Service (AWS) sponsored experiment which used existing STP cameras to document atmospheric transmission and obscuration. This experiment aided AWS modeling of meteorological data. The second QRSP was the Measurement of Atmospheric Radiance Camera - Day/Night (MARC-D/N). MARC-D/N, a low light television camera similar to the one of the CIRRIS 1A/ESS pallet, was used to collect data on celestial, day/night earthlimb, and ground sites. Funds in this project are used to manifest QRSP experiments on every available flight opportunity (four Shuttle flights are scheduled in FY 1988).

Program Element: 63402F | Title: Space Test Program (STP)
DOD Mission Area: 410 - Space Launch and Orbital Support | Budget Activity: 6 - Defense Wide Mission Support

In FY 1987, FY 1988 and FY 1989, STP will continue to develop standard Shuttle services for experiments, including power, recording and overall integration support. Hardware acquisition and procedure documentation for future Quick Response Shuttle Payload (QRSP) missions will continue. This is a continuing program. The cost estimating techniques include the use of existing Air Force Systems Command data bases for the spaceflight of QRSPs. STP program personnel are developing cost estimating capabilities as they gain experience in integration and operations activities associated with these type of payloads. Due to the unique natuze of QRSPs, the cost estimates range from category I (Comprehensive) to category III (Budgetary).

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2617, Free-Flyer Spacecraft Missions

A. (U) Project Description: This STP project advances DOD space technology by providing for the spaceflight of DOD prioritized experiments on STP developed free-flyer spacecraft. These flights are used for the demonstration of new system technologies, concepts and designs and for determining space environmental effects on military space systems. In addition, this project supports the spaceflight of secondary payloads on free-flyer host spacecraft. Expendable launch vehicles and their corresponding launch support are procured through Space Boosters, PE 35119F with STP appropriated funds. Shuttle launch support tasks are provided by PE 35171F, Space Shuttle Operations. This project supports spacecraft development and/or on-orbit operations for the STP/Defense Nuclear Agency's Polar Beacon Experiment and Auroral Research mission (Polar BEAR) and the Polar Orbiting Mission (POM), the joint DOD (Air Force)/National Aeronautics and Space Administration's (NASA) Combined Release and Radiation Effects Satellite (CRRES) mission, and the STP/Defense Advanced Research Projects Agency's Advanced Gamma-Ray and Neutron Analysis in Space mission. The project also supports the integration of numerous secondary experiment missions on host spacecraft including the Air Force Rome Air Development Center's Ionospheric Ducted Mode Experiment for long range transmission of high frequency commuincations and three Navy sponsored environmental prototype sensors to be flown on the National Oceanic and Atmospheric Administration's Television Infra-Red Observation Satellites.

B. (U) Program Accomplishments and Future Efforts:

(1) FY 1986 Accomplishments: Integration and testing was completed for the three experiment complement on the Scout launched Polar BEAR mission. The Polar BEAR experiments will image the aurora borealis during both daylight and darkness while performing communications testing to improve our ability to predict auroral conditions and their effect on command, control and communications systems. Launch preparations were initiated for the 13 November 1986 launch. Experiment integration and testing of the 54 instruments on the CRRES spacecraft continued. CRRES has two main missions. First, the Shuttle launched CRRES will perform a NASA chemical release mission in low earth orbit for three months and then will be boosted into a high altitude elliptical orbit to perform the DOD mission of evaluating the performance of state-of-the-art micro-electronics in high radiation space environment. Prior to the Challenger accident, CRRES was manifested for a launch in FY 1987. Currently, the earliest projected launch date is in FY 1989 in conjunction with another NASA payload. The [ ] This experiment will be remanifested on a future launch

opportunity. An integration feasibility study was concluded for three environmental monitoring experiments, the Remote Atmospheric and Ionospheric Detection System; the Energetic Heavy Ion Composition; and the Magnetospheric Atmospheric X-Ray Imaging Experiment to be flown on the National Oceanic and Atmospheric Administration's (NOAA) Television Infra-Red Observation Satellites (TIROS). The Spaceflight plan for the Defense Advanced Research Projects Agency's (DARPA) Advanced Gamma-ray and Neutron Analysis in Space (AGNAS) mission was approved allowing the spacecraft contract to be awarded in FY 1987. The mission is comprised of the Advanced Nuclear Gamma-Ray Spectrometer and the Advanced Neutron Detection and Analysis System. These two experiments were prioritized number one and three at the 1986 STP tri-Service Experiment Review. The initial Polar Orbiting Mission (POM) spacecraft feasibility studies were conducted. This mission will use a Transit spacecraft provided by the Navy and a Scout launch vehicle from the current Air Force inventory to support a launch in FY 1989. The experiments will provide updated mapping of the earth's magnetic fields in support of the Navy's Project Magnet and Defense Mapping Agency's requirement to update the epoch charts by 1990. This effort is currently accomplished by multiple P-3 Orion aircraft sorties over areas which overflight is authorized. The remaining areas of the earth are extrapolated by computer simulations. POM will provide worldwide coverage for the first time. Efforts to define future missions for other identified DOD experiments continued, including planning the spaceflight of the Air Force Geophysics Laboratory's Automated Charge Control experiments aboard two flights of the NOAA's next generation Geosynchronous Operational Environmental Satellites. These experiments will demonstrate the ability to neutralize static charge accumulation through the use of a neutral plasma.

(2) FY 1987 Program: The Polar Beacon Experiment and Auroral Research (Polar BEAR) mission was launched on 13 November 1986 aboard a Scout expendable launch vehicle. STP will support Polar BEAR on-orbit operations and data collection. The Combined Release and Radiation Effects Satellite (CRRES) will complete final acceptance testing in late FY 1987 and will be placed in storage at the contractor's facility awaiting a Shuttle launch. Due to the reduced FY 1987 funding, the award of the spacecraft development and integration contract for the AGNAS mission will be delayed until late in FY 1987. In addition, the initial Titan II launch vehicle funding for AGNAS has been delayed until FY 1988. DARPA provides the funds for the AGNAS experiments. This proof-of-concept demonstration is designed to

Integration of the three environmental monitoring experiments on TIROS will depend on the availability of funds. Initial integration of the Transit spacecraft for the POM will be delayed until FY 1987. The initial Scout launch vehicle funding for POM has been delayed until FY 1988. Planned feasibility studies for the next Titan II launched mission which will fly the number two prioritized experiment, a laser radar Light Detection And Ranging (LIDAR) sensor was delayed until FY 1988. The Global Positioning System (GPS) qualified satellite will be considered for a Titan II launch of the Advanced Clock/Ranging Experiment (ACRE) and other STP experiments in FY 1993. ACRE will demonstrate a hydrogen maser and advanced atomic clock technologies applicable to future GPS requirements. Studies will begin on the development and acquisition of generic spacecraft which can fly experiments on available expendable launch vehicles and thereby reducing the integration time and cost for DOD space demonstrations.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Polar BEAR on-orbit operations and data collection will continue. CRRES will be removed from storage and undergo systems level tests to ensure its readiness for a rescheduled Shuttle launch opportunity in FY 1989. The AGNAS spacecraft development and integration effort will continue on an accelerated schedule (in order to make up for the late FY 1987 start) leading to experiment integration

in FY 1989, systems level testing in FY 1990 and launch in FY 1991. Procurement of the Titan II for this mission will be initiated. The integration of the three environmental monitoring experiments on the Television Infra-Red Observation Satellites (TIROS) will continue with a planned completion in FY 1989. The integration and acceptance testing of the Polar Orbiting Mission (POM) spacecraft and the three experiments will be accelerated. The Scout launch vehicle will be procured to support the planned FY 1989 launch. The feasibility study for the Titan II compatible spacecraft for the laser radar Light Detection And Ranging (LIDAR) mission will be released and if favorable, initial integration will commence. This proof-of-concept demonstration is a prototype wind sensing instrument which may be flown on future Defense Meteorological Satellite Program operational satellites. Launch of LIDAR is scheduled for FY 1992. Feasibility studies for the Advanced Clock/Ranging Experiment (ACRE) and other STP prioritized experiments on the GPS qualification spacecraft will continue. Studies identifying spacecraft designs compatible with existing expendable launch vehicles will be completed and acquisition of such generic vehicles will begin. The planned increase in the use of expendable launch vehicles due to the Challenger accident will increase both the primary and secondary payload opportunities on host spacecraft and/or boosters. These opportunities will continue to be evaluated as a mode of spaceflight. The cost estimating techniques used for the STP include the use of existing Air Force Systems Command cost models, independent Aerospace Corporation models, contractor estimates and a large data base of experience from previous STP free-flyer spacecraft missions. Due to the differing levels of mission maturity, the cost estimates range from category I (Comprehensive) to category III (Budgetary).

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The Polar Beacon Experiment and Auroral Research (Polar BEAR) spacecraft on-orbit operation and data collection will terminate. The Combined Release and Radiation Effects Satellite (CRRES) will conclude reacceptance testing and be shipped to Kennedy Space Center, FL, in preparation for a 2Q FY 1989 Shuttle launch. The integration and acceptance testing for the Advanced Gamma-Ray and Neutron Analysis in Space (AGNAS) satellite will continue. The procurement of the Titan II launch vehicle for AGNAS will conclude and buildup will begin. The integration of the three environmental experiment on TIROS vehicles will be completed and will be placed into storage while TIROS awaits an operational requirement to launch. POM will conclude acceptance testing and will be shipped to Vandenberg, CA in preparation for the FY 1989 launch. Planning for the next Scout launched mission, P88-A, and its launch vehicle will begin. This mission will make use of the new generic spacecraft procured in FY 1988. Integration and initial testing of both the LIDAR and the ACRE missions will begin. The procurement of the Titan II boosters for these missions will be required to begin. Future secondary experiment demonstrations on host vehicles will be evaluated. The cost estimating techniques used for the STP include the use of existing Air Force Systems Command cost models, independent Aerospace Corporation models, contractor estimates and a large data base of experience from previous STP free-flyer spacecraft missions. Due to the differing levels of mission maturity, the cost estimates range from category I (Comprehensive) to category III (Budgetary).

(5) (U) Program to Completion: This is a continuing program. This on-going project will continue to provide free-flying spacecraft and integration for DOD prioritized space demonstration which are not authorized their own means to space. STP will use both Shuttle and expendable launch vehicle opportunities based on cost, schedule and overall mission requirements.

C. Major Milestones:

		Milestones		Date
(1)				
(2)	(U)	Successful Scout launch of P87-1, Polar BEAR satellite		13 November 1986
(3)	(U)	Titan II launch Television Infra-Red Observation Satellites, P86-I and P86-J, with three secondary experiments		To Be Determined
(4)	(U)	Scout launch of P86-F, Polar Orbiting Mission		FY 1989
(5)	(U)	Shuttle launch of P86-1, Combined Release and Radiation Effects Satellite	*(4Q FY 1987)	FY 1989
(6)	(U)	Scout launch of P88-A, first generic Scout-compatible spacecraft		FY 1991
(7)	(U)	Titan II launch of P86-2, Advanced Gamma-ray and Neutron Analysis in Space		FY 1991
(8)	(U)	Titan II launch of P87-A, Light Detection and Ranging experiment		FY 1992
(9)	(U)	Titan II launch of P88-B, Advanced Clock/Ranging Experiment		FY 1993

*Date presented in FY 1987 Descriptive Summary

(U) Explanation of Milestone Changes

(5) (U) Shuttle launch schedule delayed due to Challenger accident.

9. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2619, Teal Ruby Mission

A. Project Description: This project supports the development of an STP spacecraft (P80-1) for the Defense Advanced Research Projects Agency (DARPA)/Air Force Teal Ruby Mission (P888). The Teal Ruby mission, known by its primary DARPA payload of the same name, also carries Army, Navy and National Aeronautics and Space Administration (NASA) secondary payloads. The DARPA experiment will demonstrate new infrared technologies and collect data needed for the design of future During the eleven months of operation, the Teal Ruby sensor will execute over 100 missions involving more than 240 targets. The three secondary payloads operating for up to three years include - a NASA designed ion thruster experiment testing capabilities for long-term satellite station-keeping; a Navy autonomous spacecraft navigation experiment; and an Army ultraviolet spectrometer experiment studying the space ultraviolet spectrum.

B. (U) Program Accomplishments and Future Efforts:

(1) FY 1986 Accomplishments: The Teal Ruby spacecraft and the DARPA Teal Ruby flight sensor completed testing and were placed in storage awaiting launch. Due to the Shuttle Challenger accident, the planned July 1986

launch has been delayed until [ ] Teal Ruby may now be launched from Kennedy Space Center, Florida. Mission replanning, including software modifications began. The Teal Ruby spacecraft was modified to allow the satellite to be recovered upon the completion of its mission and/or depletion of the cryostat cooling system consumables.

(2) (U) FY 1987 Program: The Teal Ruby spacecraft will remain in storge at the contractor's facility except during periodic health checks. The Shuttle delay will require certain spacecraft components to be replaced. These items include limited life components such as Nickel-Cadmium batteries and risk reduction Aerospace Support Equipment such as an antenna. In addition, the delay has caused the uplink and downlink software to be modified to be compatible with the Air Force Satellite Control Facility's new Data System Modernization. The feasibility of on-orbit servicing of the five gases onboard the Teal Ruby spacecraft and cryostat will be conducted. Spacecraft refueling could double the on-orbit lifetime of the cryostat. Mission planning for the potential East Coast Shuttle launch will continue.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Teal Ruby will remain in storage except during periodic health checks. The mission planning and operations software modifications will continue. The on-orbit servicing study will be completed and if necessary, spacecraft modifications will be initiated. Due to cooperative agreements with Britian, Canada and Australia, Teal Ruby mission operations replanning will require close coordination. The cost estimating techniques used by the STP include the use of existing Air Force Systems Command cost models, independent Aerospace Corporation models, contractor estimates and a large data base of experience from previous STP free-flyer spacecraft missions. Since the costs of the remaining Teal Ruby activities are already on contract, the cost estimating range is category I (Comprehensive).

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The Teal Ruby spacecraft and sensor will remain in storage. Contractor personnel released during the storage period will be rehired and retrained. All personnel will complete system training and flight certification. Mission planning and software modifications will be completed and and used during the personnel retraining. The cost estimating techniques used by the STP include the use of existing Air Force Systems Command cost models, independent Aerospace Corporation models, contractor estimates and a large data base of experience from previous STP free-flyer spacecraft missions. Since the costs of the remaining Teal Ruby activities are already on contract, the cost estimating range is category I (Comprehensive).

(5) Program to Completion: Teal Ruby is planned to be launched in [ ]. Post storage reacceptance testing and launch readiness will occur in FY 1990. After launch, data will be collected from the Teal Ruby sensor for up to one year (or two years if the spacecraft is refueled) and from the three secondary experiments for three years.

C. (U) Major Milestones:

Milestones	Date
Teal Ruby launch on Shuttle	[ ]

Program Element: 63402F   Title: Space Test Program (STP)
DOD Mission Area: 410 - Space Launch and Orbital Support   Budget Activity: 6 - Defense-Wide Mission Support

10. (U) PROJECT OVER $10 MILLION IN FY 1988/OR FY 1989:

(U) Project: 2620, Shuttle Sortie Missions

A. Project Description: This STP project advances DOD space technology by providing for the spaceflight of experiments on Shuttle sortie missions (payloads/experiments remain in the Shuttle and are returned) for demonstrating new system technologies, concepts, and designs and for determining space environmental effects on military space systems. Through sortie missions using generic reusable, standard STP Shuttle experiment support equipment, STP accomplishes its pathfinder role of exploiting the Shuttle as a manned DOD space laboratory. The project develops the capability to control payloads in the payload bay from the aft flight deck as well as the capability to actually store and perform payload experiments on the aft/mid flight deck. The experience gained on these sortie missions will be a key element in defining military man's role in space. The project also supports the flight of secondary experiments in National Aeronautics and Space Administration's (NASA) Get-Away-Special (GAS) canisters and on other Shuttle bay support structures such as Sortie Pallet for Shuttle, Spartan, Hitchhiker-G and Hitchhiker-M being flown in the Shuttle sortie mode. The project provides for the procurement of generic reusable experiment support equipment; integration of sortie mission payloads with the Shuttle experiment support equipment and the integration of the combination into the Shuttle; mission/payload specialist training on STP hardware; launch support; on-orbit support and Aerospace Corporation systems engineering support. Specifically, this project currently supports the Cryogenic Infrared Radiance Instrumentation for Shuttle (CIRRIS) 1A/Experiment Support System (ESS) mission, Air Force Program 675 (P675). P675 proof-of-concept data will support decisions on future Air Force and Strategic Defense Initiative Organization programs. P675 is planned for an [ ] launch from Kennedy Space Center, FL. Shuttle launch support is provided by PE 35171F, Space Shuttle Operations.

B. (U) Program Accomplishments and Future Efforts:

(1) FY 1986 Accomplishments: Integration of CIRRIS 1A/ESS mission's primary and secondary experiments was completed. The pallet was placed into storage at the contractor's facility awaiting a Shuttle launch. The primary experiment, CIRRIS 1A, will gather data key to the development and operational use of the [ ] and future DOD infrared/optical space systems. The secondary experiments will gather data on the far and extreme ultraviolet (UV) to determine the utility of UV in surveillance, early warning and [ ] evaluate Shuttle payload bay contamination and to evaluate the use of an x-ray camera in monitoring nuclear materials in space. The entire CIRRIS 1A/ESS sortie mission will be controlled from the aft/flight deck of the Shuttle utilizing two trained military Manned Spaceflight Engineers and aft flight deck/payload bay interface equipment. Prior to the Shuttle Challenger accident, two STP experiments were flown in GAS canisters and another DOD payload, the Particle Analysis Cameras for Shuttle, was aboard the first flight of the NASA Hichhiker-G. The GAS payloads included the Defense Advanced Research Projects Agency sponsored Global Low Orbit Message Relay (GLOMR) Satellite and the Air Force Academy's Flexible Beam experiment. GLOMR, a prototype communications satellite, was the first DOD payload launched from a Shuttle GAS canister. The Flexible Beam experiment provided data relevant to future large space structures. PACS measured the Shuttle's particulate contamination environment from the cargo bay using 16mm cameras.

Program Element: 63402F Title: Space Test Program (STP)
DOD Mission Area: 410 - Space Launch and Orbital Support Budget Activity: 6 - Defense Wide Mission Support

This data will be used to protect future spacecraft and sensitive sensor surfaces from similar Shuttle environment contamination. Procurement of a second generation Spartan reuseable experiment carrier was initiated with the National Aeronautics and Space Administration's (NASA) Goddard Space Flight Center. The Spartan, capable of carrying up to 500 pounds of experiments, can be removed from the shuttle cargo bay by the Remote Manipulator Arm and fly in a free-flying mode near the Shuttle for up to 40 hours before being retrieved and stowed back in the Shuttle for return to earth. Mission planning and experiment selection for the first DOD Spartan mission, planned for the fourth quarter FY 1989, was completed. Efforts continued to define future sortie missions to support the spaceflight of other approved DOD experiments. Development and acquisition of equipment to support direct manned involvement with experimental payload located in the Shuttle aft flight deck and in the payload bay continued. Aerospace Corporation technical management support and program office support were funded in this project.

(2) (U) FY 1987 Program: The Cryogenic Infra-Red Radiance Instrumentation for Shuttle (CIRRIS) 1A/Experiment Support Structure (ESS) and the secondary experiments will remain in storage. Mission replanning will continue. Only essential contractor personnel will be maintained. Secondary experiments will be returned to the sponsors for upgrading and/or testing. Construction of the Spartan and its Shuttle support structure will begin later than planned due to the reduced FY 1987 Congressional appropriation. STP procurement of the Sortie Pallet for Shuttle (SPAS) will be delayed until FY 1988. The SPAS structure will provide spaceflight opportunities for STP experiments with one flight a year beginning in FY 1990. Identification, planning and procurement of generic equipment such as a large GAS canister capable of deploying Transit size spacecraft; a Grids computer and a GAS-compatible data support system (i.e. data recording and battery power) for use as standard equipment for DOD experiments will commence if funds are available after the on-going efforts are funded. Efforts will continue to define future sortie missions to support the spaceflight of other identified and prioritized DOD experiments. Aerospace Corporation technical management support and program office support are funded in this project.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The CIRRIS 1A/ESS pallet will remain in storage. Contractor personnel will be rehired and retrained. Mission replanning for an East Coast launch (vice a launch from Vandenberg AFB, CA) will be completed. Integration of the first STP experiments onto the Spartan experiment carrier will begin. The two experiments on this first DOD Spartan mission will be the Naval Research Laboratory's Far Ultraviolet Imaging Spectrometer and the Army's Star Tracker. STP will initiate procurement of a SPAS through NASA's Jet Propulsion Laboratory. STP's Aerospace Corporation technical management support and program office support are funded in this project. The techniques used by the STP include the use of existing Air Force Systems Command cost models, independent Aerospace Corporation model and contractor estimate. Since no significant pricing data base exist for Shuttle sortie type missions (except the Cryogenic Infra-Red Radiance Instrumentation for Shuttle (CIRRIS) 1A/Experiment Support System (ESS)), STP project personnel are developing cost estimating capabilites as they gain experience integration and operation activities with the Shuttle. Therefore, the cost estimates range from category I (Comprehensive) to category III (Budgetary).

(4) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request:

The first launch of a Spartan experiment carrier dedicated to DoD demonstrations will occur. Integration of the Air

Program Element: 63402F Title: Space Test Program (STP)
DOD Mission Area: 410 - Space Launch and Orbital Support Budget Activity: 6 - Defense-Wide Mission Support

Force Geophysics Laboratory's Interactions Measurements Payload for Shuttle (IMPS) on the Sortie Pallet for Shuttle (SPAS) will commence. This experiment will measure the highly energized environment in and around the Shuttle while in high inclination orbits to provide design data for future manned extra-vehicular activities and space systems in high radiation environments. This data would provide insight into the radiation dangers man will encounter in polar orbits (Shuttle based and polar platform extra-vehicular activities) and future investigations of the moon and other planets. SPAS spaceflight of IMPS will be available for a Shuttle launch opportunity in late FY 1990. SPAS is designed to carry up to 2000 pounds of experiments and fly free of the Shuttle for up to 40 hours. Aerospace Corporation technical support and program office support are funded in this project. The techniques used by the STP include the use of existing Air Force Systems Command cost models, independent Aerospace Corporation model and contractor estimate. Since no significant pricing data base exist for Shuttle sortie type missions (except the Cryogenic Infra-Red Radiance Instrumentation for Shuttle (CIRRIS) 1A/Experiment Support System (ESS)), STP project personnel are developing cost estimating capabilites as they gain experience in integration and operation activities with the Shuttle. Therefore, the cost estimates range from category I (Comprehensive) to category III (Budgetary).

(5) Program to Completion: This is a continuing program. This on-going project will continue to provide spaceflights for DOD space experiments on Shuttle sortie opportunities based on integration cost, Shuttle manifest and mission requirements. Development and upgrade of generic experiment support equipment which increases flight opportunities and/or reduces flight costs will continue. Initial studies will be conducted on the equipment necessary to make use of the National Aeronautics and Space Administration's Orbital Maneuvering Vehicle and the Space Station for DOD experiments. In [ ] will be launched and after five to seven days on orbit, recovery will take place either at Edwards AFB, CA or Kennedy Space Center, FL. At the landing site, data tapes and films will be removed and distributed. The experiments will then be returned to the experimenters and [ ] will be tested, refurbished as required, and prepared for a future mission. Both the Spartan and the SPAS will provide spaceflight opportunities for DoD experiments in FY 1990 and on an annual basis thereafter.

C. (U) Major Milestones:

		Milestones	Dates
(1)	(U)	Shuttle sortie mission of the deployable Global Low Orbit Message Relay satellite	30 October 1985
(2)	(U)	Shuttle sortie mission of the Particulate Analysis Cameras for Shuttle	12 January 1986
(3)	(U)	Unsuccessful Shuttle launch of the Radiation Monitoring Experiment	28 January 1986
(4)	(U)	Shuttle sortie mission of Far Ultraviolet Imaging Spectrometer and Star Tracker on Spartan	FY 1989
(5)		[ ]	*(March 1986) [ ]
(6)	(U)	Shuttle sortie mission of the reflight of Spartan	FY 1990
(7)	(U)	Shuttle sortie mission of Interactions Measurements Payload on SPAS	FY 1990

*Date presented in FY 1987 Descriptive Summary

(U) Explanation of Milestones Changes

(5) (U) Shuttle schedule delayed due to the Challenger accident.

11. (U) COOPERATIVE AGREEMENTS: An agreement with Great Britain, Canada and Australia exists for the Teal Ruby mission. These participants have agreed to provide targets of opportunity as well as members of their Air Forces to plan these missions. In return, they will receive only the mission data related to their targets. This is the only cooperative agreement with foreign participants in which STP is involved.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 63438F
DOD Mission Area: 410 - Space Launch and Orbital Support

Title: Satellite Systems Survivability
Budget Activity: 6 - Defense-Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		3,840	1,933	3,277	3,787	Continuing	N/A
2611	Survivability Planning and Analysis	500	50	200	200	Continuing	N/A
2612	Satellite Survivability	3,340	1,883	2,977	3,487	Continuing	N/A
2613	Ground Station/Link Survivability	0	0	100	100	Continuing	N/A

2. BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program performs survivability planning and analysis and develops the necessary prototype hardware, software, technology, operational procedures, strategy, and tactics that will provide generic survivability capabilities for the military space systems of the United States. The program is structured to provide balanced survivability between all space systems elements: satellites, data/command links, and ground stations. Space systems are required to provide critical strategic and tactical support to national decision makers and military force commanders at all levels of conflict. They specifically provide missile attack warning, strategic and tactical navigation, surveillance, communications, and meteorological information. These systems provide support to strategic, tactical, and Rapid Deployment Forces on a global basis.

Failure to protect our space systems will result in the denial of their critical support to the National Command Authorities and our military forces during crisis and conflict. The major development effort within this program is the Satellite On-Board Attack Reporting System (SOARS) - Survivability technologies under this program are made available to all satellite program offices for system level implementation.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	4,164	5,405	11,677	N/A	Continuing	N/A

EXPLANATION: (U) Reduction in FY 1987 is due to Congressional action. Decrease in FY 1988 is due to reallocation by the Air Force to higher priority programs.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: Strategic Defense Initiative (SDI) Support Programs (PE 63224C) contain a Survivability Project (#0010). This program element is managed by the Department of Defense and the Air Force which is the lead Service for the survivability project. Efforts in the SDI Support Programs complement work in this program element. PE 62601F, Advanced Weapons, and PE 64711F, Systems Survivability, develop nuclear hardening technology which is applied in PE 63438F. PE 63431F, Advanced Space Communications Capabilities, develops communication systems technology which supports survivable tracking, telemetry, and control (TT&C) stations. PE 63211F, Aerospace Structures and Materials, develops laser-hardened satellite components and materials.

6. (U) WORK PERFORMED BY: The Air Force Systems Command's Space Division, Los Angeles AFS, CA has overall responsibility for program management. Space Division executes the program, has responsibility for contractor overview and performs technical analysis in support of all projects. General Research Corp, Santa Barbara, CA, is the contractor for survivability planning and analysis. The Satellite On-Board Attack Reporting System (SOARS) is currently being competed. The Aerospace Corporation, Los Angeles, CA, provides system engineering support and is developing the technology for the Configuration Enhanced Radiation Rejection (CERR) activity.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 2611, Survivability Planning and Analysis. This project reviews the mission requirements for Department of Defense space systems, evaluates their vulnerability to current and future threats, and determines the most cost-effective methods to achieve required survivability. The results of these reviews and evaluations are published annually in a document called the Space Mission Survivability Plan. In FY 1986, development of policies and directives to implement a space system survivability strategy, consistent with the AF Space System Architecture, was completed. Development of long-term survivability criteria and investment strategies for DOD space systems, which are responsive to the growing threat, will continue in FY 1987. FY 1988 and FY 1989 activities will include annual updates of the Space Mission Survivability Plan to reflect the continued evolution of the threat, technology requirements, development priorities, and operational needs. New initiatives will also be developed as appropriate. This is a continuing program.

B. Project: 2612, Satellite Survivability. This project develops prototype survivability technologies for deployment in the 1990s, to protect those U.S. satellites critical to our national defense. It develops prototype system level capabilities to counter the demonstrated conventional co-orbital, and the potential direct-ascent nuclear and laser antisatellite threats to DOD satellites. The project also demonstrates sensor survivability and laser hardening techniques necessary to protect critical U.S. space systems against various threats at all levels of conflict. Sensor survivability efforts include development and demonstration of devices which can counter laser jamming and/or devices which can withstand levels of laser radiation sufficient to cause physical damage. Configuration Enhanced Radiation Rejection (CERR) materials to protect against the thermal effects of lasers on spacecraft structures are being developed. The Satellite On-Board Attack Reporting System (SOARS) is

SOARS will

In FY 1986, a demonstration of the shaping and bonding of Configuration Enhanced Radiation Rejection (CERR) material to satellite surfaces was completed and competition for the Satellite On-Board Attack Reporting System (SOARS) was initiated.

Due to FY 1987 Congressional funding reductions, award of two parallel concept definition contracts for SOARS was delayed until the second quarter of FY 1987. CERR hardware fabrication and qualification testing has been scaled back.

In FY 1988, testing of CERR materials will continue and the technology will be transitioned to the appropriate satellite program offices for use. Development of SOARS will continue with the detailed design of a prototype flight system. In FY 1989, SOARS prototype fabrication and qualification testing will begin. On-orbit testing of SOARS is planned for FY 1990/1991.

C. (U) Project: 2613, Ground Station/Link Survivability. This project develops concepts and demonstrates the technical feasibility of prototype hardware and new operational procedures to counter the threat against space system tracking, telemetry, and control (TT&C) and mission data links, operations centers, and ground stations. It develops both prototype and initial operational capability systems. This project provides proven survivability improvements to support validated Statements of Need and Mission Element Need Statements (SONS/MENS) and attendant acquisition programs oriented toward space system ground stations and data links. No efforts were performed in FY 1986 and FY 1987 due to funding limitations. In FY 1988, several efforts to improve link survivability will be initiated. These include developing a jam monitoring and warning unit for use at ground sites and completing a coordinated program to upgrade commercial communications into secure, anti-jam links for use by the military in times of conflict. The FY 1989 efforts will continue with these link survivability improvements.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64211F Title: Advanced Aerial Targets Development
DOD Mission Area: 452 - Aerial Targets Budget Activity: 6 - Defense-wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	10,074	10,777	9,886	3,714	Continuing	N/A
2459	Target Payload Systems	3,574	1,277	4,086	3,714	Continuing	N/A
3165	QF-106 Full-Scale Aerial Target System	6,500	9,500	5,800	0	0	21,800

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Aerial targets are essential to ensure air-to-air weapons effectiveness and mission proficiency of our tactical air crews against enemy aircraft. The overall objective is to improve air-to-air weapon system accuracy and reliability by developing aerial target systems for Air Force weapon system test and evaluation. In addition, full-scale targets (QF-100 and QF-106) are used to support US Army air defense test and evaluation programs such as the Divisional Air Defense follow-on program, Stinger, Patriot, and Improved Hawk. The targets being developed provide a cost effective mix of full-scale and subscale aerial targets. Full-scale targets provide a fully representative target with realistic maneuvering performance, radar cross section, and afterburning engine infrared signature. Subscale targets are a lower cost supplement used when threat simulation fidelity is not as critical. The Target Payload Systems task will increase target effectiveness by improving subsystems for missile scoring and by developing subsystems which will provide target representative radar and infrared signatures. QF-106 development will provide a follow-on to the QF-100 full-scale targets which will complete procurement in FY 1987.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	13,119	11,149	11,422	N/A	Continuing	N/A
Missile Procurement	0	0	27,200	N/A	74,365	101,565

Explanation: (U) Reduction in FY 1986 development funds was due to a one year delay in the Missile-End-Game Scoring program to expand the technological approach. The FY 1988 reduction is for higher priority Air Force programs resulting in a reduction in the pyrophoric afterburner simulator task. The FY 1988 procurement funding change is due to a one year delay in procurement of the QF-106, initially planned for late FY 1988.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Missile Procurement:						
Project 3165, QF-106						
Funds	0	0	0	24,800	70,100	93,600
Quantities	0	0	0	48	144	192

5. (U) RELATED ACTIVITIES: The three Services actively cooperate in the development of various target systems and subsystems. Coordination is insured by the Joint Logistics Commanders through an active Joint Technical Coordinating Group for Aerial Targets. Additionally, formal coordination through the Department of Defense Armament/Munitions Requirements, Acquisition, and Development Committee prevents duplication. Targets are procured under PE 35116F, Aerial Targets.

6. (U) WORK PERFORMED BY: Sperry Corporation, Aerospace & Marine Group, Albuquerque, NM (Project 3165, QF-106); Beech Aircraft Corporation, Wichita, KA (Project 2459, Target Payload Systems), Santa Barbara Research Center, Goleta, CA (Project 2459, Target Payload Systems); and Teledyne Ryan Aeronautical, San Diego, CA (Project 2459, Target Payload Systems).

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 2459 - Target Payload Systems. FY 1986 accomplishments include continued development and integration of the APC-4 infrared plume generator pod into the MQM-107B/D subscale target. Eight pod sets were delivered in Jan 1986. Qualitative operational test and evaluation began in May 1986. Ground tests of a pyrophoric afterburner simulator were conducted with favorable results. Waterproof tests were conducted on the ALE-40 chaff/flare dispenser to determine best installation on subscale targets for water recovery. Infrared measurement of surrogate threat aircraft continued. In FY 1987, development improvements of the APC-4 will continue. Improvements to be incorporated in the MQM-107D will be flight tested on the MQM-107B (MQM-107D not available until FY 1988). Pyrophoric afterburner simulator development will continue with flight test on the F-4 aircraft. A contract for electronic countermeasures (ECM) on subscale and full-scale targets was awarded in Oct 1986. In FY 1988, a contract for Missile End-Game Scoring (MEGS) for the MQM-107 and QF-106 will be executed. Development and testing of the improved target ECM system will continue. In FY 1989, MEGS development will continue with some testing to take place in late FY 1989. Development test and evaluation/initial operational test and evaluation (IOT&E) of the ECM system will be completed. In FY 1990 IOT&E of MEGS will be conducted and a production decision made. Production of the ECM system will begin.

Program Element: 64211F   Title: Advanced Aerial Targets Development
DOD Mission Area: 452 - Aerial Targets   Budget Activity: 6 - Defense-wide Mission Support

B. (U) Project: 3165, QF-106 Full-Scale Aerial Target System. The QF-106 will be the full-scale target for the early 1990s. It replaces the QF-100, which is programmed for final procurement in FY 1987 and will be fully attrited by the third quarter of FY 1990. Full-scale development was initiated in FY 1986 to convert retired F-106 aircraft into remotely controlled targets, with production deliveries beginning in FY 1990. The QF-106 project will include design and integration of remotely controlled autopilot modifications; command and control telemetry systems; missile scoring systems; and infrared and electronic countermeasures. In FY 1987, development will continue through critical design review. Initial developmental QF-106 targets will be built and begin contractor flight tests in the final quarter. FY 1988 funds are required to continue flight tests to finalize the command and control autopilot design and integration. This will be followed by Air Force flight tests and a production decision in FY 1989. QF-106 design will take advantage of F-106 similarity to the F-102, which served as the PQM-102 full-scale target, and will use the digital autopilot and other advances incorporated in the QF-100 design.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E PROGRAM DESCRIPTIVE SUMMARY

Program Element: 64227F
DOD Mission Area: 430 - Non-System Training Devices

Title: Flight Simulator Development
Budget Activity: 6 - Defense-Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		111,570	96,412	61,701	64,467	Continuing	N/A
2325	Simulator Development Activities	8,681	8,400	6,900	5,744	Continuing	N/A
2632	B-52 Offensive Avionics Station	7,650	5,000	0	0	0	31,950
2687	EF-111A Operational Flight Trainer	955	98	0	0	0	12,703
2769	Simulator Update Development	2,426	2,947	6,946	4,600	Continuing	N/A
2851	Standard Department of Defense (DOD) Simulator Data Base/Common Transformation Program	452	2,947	3,000	1,490	100	8,270
2854/5	C-5/C-141 Aerial Refueling Part Task Trainer	271	196	0	0	0	11,358
2901	B-1B Weapon System Trainer	40,393	13,700	761	0	0	106,066
2902	T-46 Operational Flight Trainer	3,851	0	0	0	0	11,881
2903	F-15/F-16 Simulator for Air-to-Air Combat	3,264	1,964	0	0	0	7,716
2968	Modular Simulator Design	650	1,909	3,500	2,500	300	8,886
2997	GBU-15 Part Task Trainer	8,195	8,750	2,670	0	0	19,756
2998	LANTIRN Simulator	7,075	18,155	7,713	3,390	600	37,446
2999	LANTIRN Part Task Trainer	166	6,720	8,375	540	0	15,868
3000	KC-135 Operational Flight Trainer	11,484	11,838	6,433	1,000	300	32,483

Program Element: 64227F
DOD Mission Area: 430 - Non-System Training Devices

Title: Flight Simulator Development
Budget Activity: 6 - Defense-Wide Mission Support

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
3105	F-15E Weapon System Trainer	14,637	6,400	196	0	0	33,067
3135	Advanced Training System	1,420	2,588	2,188	1,786	3,337	11,319
3143	Advanced Tactical Fighter (ATF)	0	200	1,909	4,607	275,300	282,016
3147	Ada Simulator Insertion	0	2,700	0	0	0	4,700
3282	C-17 Aircrew Training System	0	1,900	11,110	38,810	45,900	97,720

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This is a continuing program element for the development of aircrew flight simulator techniques and training devices. The objectives are to adapt flight simulation technology developed in the laboratories and industry to satisfy current and future training requirements and to develop prototype training devices.

3. (U) COMPARISON WITH FY 1987 Descriptive Summary : ($ in thousands)

RDT&E	128,436	102,736	62,351	N/A	Continuing	N/A

EXPLANATION: (U) FY 1986 reduction of $16.9 million due to Gramm Rudman, inflation adjustment, Small Business Independent Research, and reprogrammings. FY 1987 reduction due to Congressional action.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

Aircraft Procurement:						
2632 Funds (PE 11113F)	12,700	0	0	0	0	12,700
Quantities	12	0	0	0	0	12
2769 Funds (PE 27128F)	15,300	0	0	0	0	15,300
Quantities	14	0	0	0	0	14
2769 Funds (PE 84741F)	4,700	6,000	1,500	0	0	15,500
Quantities	3	4	3	0	0	11
2901 Funds (PE 11126F)	72,000	1,500	1,600	4,900	0	197,870
Quantities	4	0	0	0	0	12
2997 Funds (PE 27131F)	0	0	2,500	0	0	2,500
Quantities	0	0	2	0	0	2
2997 Funds (PE 27252F)	0	0	2,100	0	0	2,500
Quantities	0	0	1	0	0	2,100

Program Element: 64227F
DOD Mission Area: 430 - Non-System Training Devices

Title: Flight Simulator Development
Budget Activity: 6 - Defense-Wide Mission Support

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
3000	Funds (PE 11142F)	0	39,400	2,900	12,800	18,600	73,700
	Quantities	0	9	0	4	5	18
3105	Funds (PE 27130F)	33,900	37,700	32,900	76,300	45,300	226,600
	Quantities	1	1	1	2	1	6

5. (U) RELATED ACTIVITIES: Technologies from inter- and intraservice coordination of science and technology and the Air Force Human Resources Laboratory (AFHRL) science and technology programs provide support to this program element. Specific programs include: PE 62205F, Training and Simulation Technology; PE 63227F, Advanced Simulator Development; and PE 63851F, Innovations in Education and Training.

6. (U) WORK PERFORMED BY: The Deputy for Simulators, Wright-Patterson AFB, OH, is responsible for the majority of work performed in this element. Ogden Air Logistics Center manages the modification to the F-4E/G and KC-135 simulators. AFHRL is responsible for the F-15/F-16 Simulator for Air-to-Air Combat (SAAC). The following is a list of the contractors and their contract efforts: Singer-Link, Binghamton, NY (F-4E/G computer replacement, F-15/F-16 SAAC upgrade, C-135 modifications, Low Altitude Navigation and Targeting Infrared System for Night, and B-52 Offensive Avionics Station;) AAI Corp, Baltimore, MD (EF-111A Operational Flight Trainer and Simulator for Electronic Warfare Trainer modification); Reflectone Corp, Tampa, FL (C-5A/C-141B Aerial Refueling Part Task Trainer and T-46A Operational Flight Trainer); Boeing Military Airplane Co, Huntsville, AL (B-1B Simulator System and KC-135 Refurbishment); and Goodyear Aerospace Corp, Akron, OH (F-15E Weapon System Trainer). Fourteen other contractors are performing work valued at $41.9 million in FY 1988 and $63.8 million in FY 1989.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 2325, Simulator Development Activities. This project funds engineering development of training system technology techniques and preproduction or first article training devices to satisfy current and future training requirements. The project also addresses identified deficiencies in training capabilities, improves concurrency between aircraft and flight simulators, and reduces life cycle costs. Approximately 40 unique tasks are being accomplished within this project. They include radar sensor data base development; evaluation of the Synthetic Aperture Radar simulation application; completion of engineering development and evaluation of a helmet-mounted visual display; three promising approaches to satisfy the requirement for a full field of view visual system; development of an authoring system for Computer-based Instructional Systems; and development of a generic trainer and other similar small part task trainers. In FY 1986, we completed analysis of aircraft versus simulator handling qualities; continued engineering development of a multiple Instructor Operator Station; continued high resolution radar simulation development and

advanced radar simulation test methodology. We also initiated competitive development of a low cost visual system. Planned in FY 1987 is continued development/evaluation of user friendly authoring language for Computer-Based Instructional Systems (CBI), a visual sensor commonality study, evaluation of state-of-the-art visual display systems for engineering acquisition specifications; and evaluation of an embedded training concept for future programs. Planned in FY 1988 are assessments of artificial intelligence for Instructor Operator Station (IOS) and CBI, continued development of multi-cockpit IOS and initiation of development of multi-station IOS, and continued evaluation of infrared and electronic combat simulation. We also plan to initiate development of an embedded training prototype program for training/cost trade-offs analysis. In FY 1989, we will continue artificial intelligence research for IOS in support of complex tactical missions and continue development and interpretation of multi-cockpit IOS. We will also continue development of an embedded training prototype maintainability and reliability data base, complete full field-of-view visual system development and address a tactical simulator prototype for air-to-air/air-to-ground combat environment, and initiate development of a low cost image generator for sensor simulation. Work tasks within this project are based on Category II through IV cost estimates. Complies with OSD guidelines as follows: Provides data that will be used as generic building blocks in the development of new training devices; develops sensor simulation for generic infrared and visual systems; is the only project that addresses requirements, and test and specification development with an extensive framework developed for front-end analysis. The emphasis is on generic development for use on all simulator programs to reduce acquisition and life cycle costs, reduce acquisition time, and improve reliability, maintainability and availability.

B. (U) Project: 2769, Simulator Update Development. This project updates training systems to maintain and improve their supportability and effectiveness. It includes digitization and upgrade of the C-135 Operational Flight Trainer (OFT) and development of a C-130 Aircrew Training System (ATS). It also replaces the logistically unsupportable terrain model board visual system on the Undergraduate Pilot Trainer-Instrument Flight Simulator (UPT-IFS) with a computer-generated image visual system. In FY 1987, we will complete fabrication and testing of the T-5 electronic warfare simulator upgrade, conduct design reviews and complete prototype fabrication, and begin in-plant testing for the computer replacement for the F-4 OFT. We will also exercise production options for the F-4 OFTs and UPT-IFS visual system. In FY 1988, we will procure three visual systems to complete the UPT-IFS replacement. The C-130 ATS develops courseware, scheduling management, and evaluation tools necessary to integrate current facilities, training devices, and operational equipment into a state-of-the-art training system. The system includes proficiency-based syllabus development; automated daily scheduling of students, instructor pilots, aircraft and simulators; automated record keeping and evaluation; computer-based instruction; and structuring of the program to allow generically based research and development studies. The contractor guarantees fully qualified students in all aircrew positions at the formal school. Source selection and contract award will occur in FY 1987. In FY 1988, the contractor will begin phasing in the ATS to replace Air Force simulator maintenance and instructor personnel. In FY 1989, development will be completed and the prototype implementation fielded. In FY 1990, the C-130 ATS will be fully operational. Compiles with OSD guidelines as follows: addresses the development of a Total Contract Training System for C-130 aircrews using best commercial practices.

C. (U) Project: 2851, Standard DOD Simulator Data Base/Common Transformation Program. The Joint Logistics Commanders initiated this project to develop a standard DOD digital data base that uses Defense Mapping Agency data for displays for aircrew training (e.g., visual, radar, infrared). The transformed data base would be provided as Government Furnished Equipment to simulator manufacturers, eliminating the cost associated with the current approach of developing a unique system for each simulator program that requires sensor simulation. In FY 1985, the first and second tasks (requirements evaluation and cost benefit analysis) of this six-task project were completed. Task 3 (a transformation efficiency study) and Task 4 (data base requirements definition which defines both data base content and the data base generation concept) were also completed. Task 5 (program development) will begin in FY 1987 and be completed in FY 1989. Test, evaluation and implementation of this program occurs in FY 1988 and FY 1989. Compiles with OSD guidelines by developing standard data base and transformation programs for sensor simulation on all training devices to reduce acquisition and life cycle costs.

D. (U) Project: 2901, B-1B Simulator System. The Strategic Air Command requires training devices for all B-1B crew members. Training tasks include mission rehearsal for takeoff and landing, navigation, air refueling, threat analysis/countermeasures, low level penetration, weapons delivery, and emergency procedures. Emphasis is placed on integrated crew training and other tasks that cannot be accomplished in the aircraft including safety of flight restricted emergency procedures and Emergency War Order rehearsal. In Phase I, two contractors competed through preliminary design review; Boeing Military Airplane Co. was selected to complete the acquisition in Phase II. Devices procured include five Weapon System Trainers (WSTs) simulating all four crew positions, two stand-alone Mission Trainers (MTs), simulating the offensive and defensive positions, and six Cockpit Procedures Trainers (CPTs), simulating all four crew positions. The FY 1986 program completed initial development, fabrication, and hardware/software integration of the prototype WST, and in-plant test commenced. The production option for Lot II (two WSTs and two MTs) was also exercised. Six CPTs will be delivered to the field in FY 1987. The prototype WST will be delivered in Oct 1987, while production WST units 1, 2, and 3 will be delivered in FY 1988, and Mission Trainers 1 and 2 in FY 1989. WST unit 4 will also be delivered in FY 1989. OSD guidelines do not apply, project initiated prior to FY 1986.

E. (U) Project: 2968, Modular Simulator Design. A strong requirement exists to reduce life cycle cost, reduce development lead time, improve our ability to deliver simulators to the field concurrently with the aircraft (to keep the configuration current with the system fielded and to update simulators as new and different systems are needed for training), and to increase the competitive contractor base. Phase 1 was a Request for Information from the simulator industry to assess, from an industry perspective, the feasibility of modular simulators, the advantages, disadvantages, cost, and potential impact on technology. The second phase was a competitive effort with Logicon and the Boeing Co. to identify the tools necessary to implement modularity and to develop a suggested specification, statement of work, and implementing strategy. The evaluation of Phase II was completed in FY 1985. This was a tri-service effort to analyze the contractors' approaches, and then identify an approach to Phase III given the technical, cost, and supportability considerations identified in the first two phases. In FY 1986, the Request for Proposal was developed and released for Phase III; the contract will be awarded in the second quarter of FY 1987. In FY 1988, basic design and definition will be completed (in time to support the Advanced Tactical Fighter Aircrew Training System). The module design and

definition will lay the foundation for the demonstration and validation phase in FY 1988 through FY 1990. Complies with OSD guidelines by reducing acquisition and life cycle costs by development of standard interfaces between simulator pieces using best commercial practices.

F. (U) Project: 2997, GBU-15 Part Task Trainer (PTT). The Tactical Air Forces require a low cost, ground-based device for training F-4E and F-111F Weapon System Operators (WSOs) in the employment of the GBU-15 and AGM-130 precision guided munitions. Current training systems cannot train operators on the electro-optical/infrared mission specifics, and the costs to integrate this capability into the existing devices are prohibitive. The GBU-15 PTT will provide training in target acquisition and recognition and in operation and guidance of GBU-15 and AGM-130 weapons from prelaunch to target impact. Four (one development, three production) GBU-15 PTTs will be procured, each consisting of a student station for the WSO, a limited instructor station, a computational system, and a high quality image generation system to provide the simulated video and visual environment effects. In May 1986, the contract was awarded to Honeywell, Inc, and the option for AGM-130 development was exercised 1 Jul 1986. During FY 1987, the majority of the development effort (fabrication of the student, instructor, computational, and image-generated subsystems) will be completed. During FY 1988, the option to produce follow-on units will be exercised. In FY 1989, the production trainers will be deployed and Contract Logistics Support options exercised for each unit. This is a Category III cost estimate. Complies with OSD guidelines as follows: Part Task Trainer being developed to satisfy training requirement versus a full mission trainer or a weapon trainer system.

G. (U) Project 2998, Low Altitude Navigation and Targeting Infrared System for Night (LANTIRN) Simulator. The LANTIRN simulator, when integrated with an Operational Flight Trainer (OFT), will provide the capability required to fully train pilots in LANTIRN usage. The Tactical Air Forces require a safe, efficient means of training the LANTIRN mission in a high threat, night, advise weather, heavily task loaded environment simulating combat. A development contract was awarded to Singer-Link Co. in June 1986. Initial design will be completed in FY 1987 as well as hardware subsystems fabrication and software development. FY 1988 will mark the beginning of integration of hardware and software, followed by contractor in-plant tests and government qualification tests. Integration of the LANTIRN simulator with the F-16 OFT will also start in FY 1988, and production options for four F-16 LANTIRN simulators will be exercised at that time. In FY 1989, integration of the LANTIRN with the F-16 OFT will be completed and delivery is scheduled for the first quarter of FY 1990.

H. (U) Project: 2999, LANTIRN Part Task Trainer (PTT). The complexity of the LANTIRN system and inherent danger of operating close to the ground in the night and adverse weather requires initial training that enhances safety and speeds understanding of system operation. LANTIRN PTTs will effectively train pilots in LANTIRN (F-16, F-15E) switchology, modes of operation, and F-15E avionics. These training devices will provide an accurate representation of the aircraft cockpit, including all functional controls and switch responses, to provide aircrews with familiarization training that will provide the lead in training for the more complex and dynamic LANTIRN simulation in Project 2998. Source selection activities commenced in FY 1986 and will end with contract award in the first quarter of FY 1987. The initial development will be the F-15E PTT. FY 1987 will include design and the option to start the F-16 PTT development. Production options will be exercised in FY 1988. OSD guidelines do not apply; project initiated prior to FY 1986.

I. (U) Project: 3000, KC-135 Operational Flight Trainer (OFT) (MB-26 Refurbishment). To train its KC-135 crews, the Strategic Air Command (SAC) needs to refurbish and update their outdated MB-26 procedures trainers. The devices are expensive to maintain, frequently out of commission, and unrealistic. In July 1981, the Aircraft Safety and Operations Review Board, after investigating several KC-135 accidents, highlighted the need for new KC-135 simulators, particularly for engine-out and emergency procedures training. The KC-135 OFT will simulate the pilot and copilot stations and incorporate an on-board instructor's station and a computer image-generated visual system for takeoff, landing and engine-out training. The OFT will also accurately simulate the total aircraft flight envelope and will meet SAC requirements for annual instrument evaluations. A total of 18 trainers will be optioned for upgrade to the KC-135 OFT configuration (approximately eight in the KC-135A configuration and ten in the KC-135R configuration). The contract was awarded to the Boeing Military Airplane Co. on 20 Mar 1986. In FY 1986, the contractor began initial design and development of the KC-135R flight station, aerodynamics, student stations, instructor station and computational system. In FY 1987, flight data will be collected, the initial design will be completed, and hardware and software integration will begin. The option for development of the KC-135A configuration and the production option for the first lot will also be exercised. Starting in FY 1988, contractor in-plant testing and government qualification testing will be conducted, followed by shipment to the field for final acceptance testing. Additionally in FY 1988 through FY 1990, production options for the remaining devices will be exercised. This is a Category I cost estimate. OSD guidelines do not apply--project initiated prior to FY 1986.

J. (U) Project: 3105, F-15E Weapon System Trainer (WST). A fighter that conducts interdiction bombing as well as air-to-air missions must be supported by an aircrew training system that trains both missions. The F-15E WST will train both pilot and weapon system officers and will include Low Altitude Navigation and Targeting Infrared System for Night (LANTIRN) simulation. The trainers will be a modification to the F-15 Operational Flight Trainer already being manufactured by Goodyear Aerospace Corp. A total of six WSTs will be procured. In FY 1985, the development contract for the WST was awarded and the Request for Proposal for production of the first WST with priced options for units 2 and 3 was released. In FY 1987, the basic design will be completed. Also, fabrication of cabling assemblies begins and the production contract will be awarded. Detailed design of the flight station, instructor station, computational system, and LANTIRN simulation will continue. In FY 1987, hardware/software integration and contractor in-plant tests will be completed and production for unit 2 exercised. In FY 1988, Combined Government/Contractor Testing will be accomplished and the first trainer will be delivered. The production option for unit 3 will be exercised in FY 1989. OSD guidelines do not apply--project initiated prior to FY 1986.

K. (U) Project: 3135, Advanced Training System (ATS). Changes to the Air Force training environment have resulted in an increased training workload at Air Training Command (ATC) Technical Training Centers. More complex equipment has increased student instructional needs. As training requirements have increased, the number of experienced instructors has decreased. ATC is therefore increasingly unable to conduct remedial or individualized instruction. This results in a greater number of personnel in the training pipeline, increased attrition, lower achievement, and ultimately reduced operational readiness. ATS will provide information presentation, demonstration, drill and practice, evaluation, feedback, and remedial training. Its main goals are to free instructors for remedial instruction in complex

tasks, promote efficient training methods, and provide rapid course updating. The ATS program responds to the Defense Science Board 1982 Summer Study on Technical Training which recommended improvements to our training approach. The ATS is a three-phased program to provide a computer-based training system to alleviate this deficiency. Phase I was a contracted concept exploration and validation effort completed in Sep 1984 and was funded and managed by ATC. Phase II develops the prototype system for two courses at one ATC Technical Training Center. Phase III acquires systems for four other centers. In FY 1985, the system specification was drafted for Phase II, and the development site and courses were selected. In FY 1986, the development contract was awarded. In FY 1987, the initial computer hardware selection will occur. In FY 1987-1989, we will complete development and award a production contract. OSD guidelines do not apply--project initiated prior to FY 1986.

L. (U) Project: 3143, Advanced Tactical Fighter (ATF) Training System. The Tactical Air Forces require an ATF Training System to meet Manpower, Personnel and Training needs to support operations personnel assigned to the weapon system. Required training tasks include initial, continuation, upgrade, on the job training and mission qualification levels which emphasize new job requirements; Front-End Analysis (FEA) process will define all training requirements and integrate these findings into an ATF Total Training System which will optimize program accuracy, timeliness, currency and economy. The FEA is broken down into two activities: In Step 1, the prime weapon system contractors were required to accomplish an FEA concurrently with their weapon system design task. That process will result in the description of a total training system to include impact of new technologies, definition and a functional description of all system elements. Step 2 will require an independent Front-end Analysis (FEA) specialist to integrate all of the individual contractor data, analyze the user training requirements and present to the Air Force recommendations and alternatives for implementing, supporting and operating a total training system. In 1985, the Advanced Tactical Fighter (ATF) Demonstration/ Validation Request for Proposal was amended to include the accomplishment of FEA by each of the winning contractors as an integral element of their design process. The amendment included technical, management and supportability perspectives. In FY 1986, the ATF Demonstration/Validation Source Selection was started and was completed through contract award in first quarter FY 1987. In late FY 1987, the midterm review of each ATF contractor will be accomplished. The FEA process required for the total ATF training system definition will be implemented through an independent FEA contractor. In late FY 1988 or early 1989, all ATF Training System FEA data will be analyzed and presented to the Air Force for implementation. Complies with OSD guidelines by early consideration of training requirements to effect concurrent delivery in the most cost effective manner.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3282, C-17 Aircrew Training System (ATS)

A. (U) Project Description: This project is designed to meet the needs of the Military Airlift Command (MAC) and Air Reserve Forces in supplying initial and continuation training for C-17 crew members. Training will be totally contractor administered and supported, with MAC evaluating the final product--a fully qualified aircrew member. There will be a main facility for initial through instructor training, learning centers at four main operating bases for continuation training, and two sites for the training of Guard and Reserve personnel. Emphasis will be on integrated

crew training and training tasks that cannot be accomplished in the aircraft, including those related to safety of flight, emergency procedures, and others for which a suitable flight training environment does not exist. The training system will be developed concurrently with the aircraft design effort, allowing a training system to be available at the formation of the first operational squadron. In September 1985, Douglas Aircraft began delivery of detailed task listings with semiannual updates until the end of the Full Scale Development contract. An eight-month front end analysis effort by Illinois Institute of Technology Research Institute (IITRI) is designed to provide a preliminary aircrew master task listing, and an aircrew evaluation standard was completed in FY 1986. Acquisition of the actual C-17 ATS has been divided into two phases to sustain competition as long as possible. Phase I will be a full and open competition to determine which company has the best capability to field and support an ATS. Two contractors will be chosen to provide detailed functional designs of their total systems. Phase II will begin after the selection of one of these contractors to complete the final design, development, testing, deployment, activation, and operation and support of the training system. Complies with OSD guidelines through early consideration of training needs with the parent weapon system, and development of a training system using best commercial practices.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Not Applicable.

(2) (U) FY 1987 Program: Contract award for the C-17 ATS is projected for July 1987. At that time two contractors will be chosen in a full and open competition to begin a detailed design of their systems.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Downselect from two contractors to one, to develop and produce the training system, with total control over courseware and ground based instruction, full logistics support, total system management and operation, guaranteeing student throughput and instruction quality. Number and types of devices are not yet final but estimates were arrived at by comparing the anticipated C-17 student throughput with that on the C-5 Aircrew Training System (ATS) contract. The estimate was formally accomplished in June 1986 and is currently being reviewed. Because data does not exist for the cost of a trained student (although the student is the final product), the estimate assumed that a reasonable and reliable cost estimate for an ATS could be arrived at by predicting the types and numbers of devices to be used by the contractor. Because of this approach, it is a Category IV cost estimate.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The effort in 1988 to develop and produce a training system will continue through preliminary design, critical design and the beginning of hardware/software integration. Configuration control procedures, update management, course syllabus, and overall system management will be defined.

(5) (U) Program to Completion: The development portion of the C-17 ATS will continue until first site activation in June 1991. Annual production options will be provided to activate and support successive ATS sites. The final site will be activated in FY 1999 and the contract will terminate in FY 2003.

C. (U) Major Milestones:

	Milestones	Dates
(1)	(U) Draft Request for Proposal Release	August 1986
(2)	(U) RFP Release	December 1986
(3)	(U) Proposal Submittal	January 1987
(4)	(U) Contract Award	July 1987
(5)	(U) Receive Downselect Proposals	April 1988
(6)	(U) Downselect Decision	September 1988
(7)	(U) ATS Ready For Training--First Main Operating Base	June 1991

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64609F — Title: R&M Technology Insertion Program (RAMTIP)
DOD Mission Area: 475 - Central Supply Maintenance — Budget Activity: 6 - Defense-Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		5,725	13,563	20,365	26,279	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Air Force must improve the reliability and maintainability (R&M) of current, in-production and future weapon systems if we are to effectively meet the challenges of the coming decades. The growing Soviet threat has made operating bases and the systems, people, and support equipment located there increasingly vulnerable. Successful operations in this environment demand increased warfighting capability, survivability, and mobility. In addition, manpower availability will decrease over the coming decade making it more difficult to recruit the necessary high quality technical personnel needed to maintain the modern weapons required to defeat the threat. Finally, current budget realities demand lower operations and support costs. To help overcome these challenges, the Air Force recently implemented an action plan called Reliability and Maintainability (R&M) 2000. A key element in this multi-faceted effort to institutionalize R&M is to consolidate various Air Force R&M initiatives into a cohesive program. This action will provide essential improvements in management, control, and coordination of the Air Force's R&M program. RAMTIP represents one aspect of this effort. Its purpose is to accelerate the transition of new R&M technologies into fielded, in-production, and future systems. The leverage/payoffs to be gained from this effort are: greater combat capability; increased survivability of the combat support structure, more efficient use of mobility and manpower assets, and lower Operational and Support costs. The funding ramp-up in FY 1988 and 1989 is consistent with and essential to the Air Force's effort to improve R&M in its weapon systems.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	6,206	18,031	23,594	N/A	Continuing	N/A

EXPLANATION: The FY 1987 reduction is attributable to Congressional action. The reduction in the FY 1988 funding is the result of lower than anticipated growth in the proposed Air Force budget.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: The projects in this program currently interface with: PE 64201F, Project 2519 - Generic Radar Improvements; PE 64706F - Life Support Systems; PE 64231F - C-17 Program; PE 64226F - B-1B Program; PE 41115F - C-130 Program; PE 27130F - F-15 Program; PE 11133F - SR-71 Program; and PE 64312F - Intercontinental Ballistic Missile Modernization.

Program Element: 64609F   Title: R&M Technology Insertion Program (RAMTIP)
DOD Mission Area: 475 - Central Supply Maintenance   Budget Activity: 6 - Defense-wide Mission Support

6. (U) WORK PERFORMED BY: Overall management of this effort will be accomplished by Headquarters USAF, Washington, DC. Other involved organizations include: Air Force Systems Command (AFSC), Andrews AFB, MD; Product Divisions; Labs; Air Force Logistics Command (AFLC), Wright-Patterson AFB, OH; and Air Logistics Centers (ALCs).

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 64609F, RAMTIP

A. (U) Project Description: Today, and for the foreseeable future, a combat capability shortfall exists, vis-a-vis the current and postulated Soviet threat. The introduction of new weapon systems will improve the situation to some degree, but will only partially close the gap. To help overcome this shortfall, it is essential that the Air Force accelerate the transition of promising new technology into current, in-production and future weapons systems. Critical to this effort is RAMTIP.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: The FY 1986 program continued work on the transition of three key reliability & maintainability (R&M) technologies. The first of these efforts is the insertion of an On-Board Inert Gas Generating System (OBIGGS) into the C-17. OBIGGS performance will be established over a wide range of mission parameters so that data will be available not only for the C-17 but also for development of design criteria for the C-130, C-5, C-141 and other airlift aircraft. Benefits from this project include: elimination of the current liquid nitrogen (LN2) system and reduction vulnerability due to ground based support facilities, equipment and personnel; and $21 million reduction in operation and support (O&S) costs over the current LN2 inerting system. The second project is the Advanced Rocket Nozzle Inspection System (ARNIS). This initiative transitions, from the lab to the manufacturing process, a nondestructive evaluation technique using low energy x-ray Computed Tomography for testing carbon-carbon rocket nozzles. The adaption of this technology will reduce costs by a factor of five and enhance production quality (100% reliable inspections) and productivity. Initial application will be the Small Intercontinental Ballistic Missile (SICBM) program. The third project is the B-1B Central Integrated Test System (CITS) Expert Parameter System (CEPS). This project applies artificial intelligence to analyze in-flight recorded system status data (CITS) for the purpose of improving aircraft readiness. CEPS will accomplish this by reducing test time by 60%, "cannot-duplicate" by 30% and "retest-ok" by 30%. These reductions equate to increased combat capability and lower support costs (approximately $160 million) over the life of the B-1B.

(2) (U) FY 1987 Program: The FY 1987 program continues the FY 1986 projects, i.e., On-Board Inert Gas Generating System (OBIGGS), B-1B Central Integrated Test System (CITS) Expert Parameter System (CEPS), and Advanced Rocket Nozzle Inspection System (ARNIS). In addition, the Air Force is beginning the transition of some promising new technologies that will make, when fully applied, major improvements to the reliability and maintainability of Air Force weapon systems. The first of these efforts is the incorporation of Molecular Sieve Oxygen Generating System (MSOGS) into the F-15E fighter aircraft. From studies and operational experience it is known that MSOGS provides significant improvements over the current Liquid Oxygen (LOX) system. These improvements include: higher reliability -by a factor of 10; greater survivability - reliance on complex LOX infrastructure not needed; decreased mobility requirements - 3 to 5 pallets saved per deploying squadron; decreased manpower requirements - overseas, 10 manpower spaces saved/stateside, 3 manpower positions saved; decreased costs - cost/benefit analysis indicates that MSOGS costs less than the LOX (approximately $3.0 million saved per squadron - life-cycle). Another high leverage initiative is the incorporation of new Klystron Power Amplifier technology into the E-3A. This new technology tube will dramatically improve the operational reliability (fivefold improvement over current power amplifier) and availability of the E-3A while reducing on-aircraft maintenance time by 70%. This effort will also reduce supportability costs and provide a suitable replacement for an item with an identified obsolescent source and source of repair. Finally, the Air Force is transitioning the latest advances in polymer fuze development into conventional impact weapons. First application will be the BLU 109. Anticipated benefits include; a higher impact resistance over current fuzes, a 10% increase in storage reliability, and a $350 reduction in cost for every conventional weapon it is used in. The greater number of weapons applied to, the greater the savings. For the BLU 109 this equates to a $12 million savings.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: As stated earlier, the thrust of the Air Force R&M effort is to improve the reliability and maintainability of our fielded, in-production, and future weapon systems. The RAMTIP program is a key part of this effort. Our objective under RAMTIP is simple, to accelerate the transition of promising high leverage R&M technology from the lab or industry into our weapon systems where it can provide operational and cost benefits. In FY 1988, the Air Force will begin the transition of some key R&M technologies. The first of these is the incorporation of an Integrated Communications Navigation Identification (ICNIA) System into the F-111. This Very High Speed Integrated Circuit (VHSIC) based system is also a potential candidate for application into the F-15 and F-16. Preliminary estimates indicate that the incorporation of ICNIA will improve reliability over the current system by a factor of 80. This impressive gain in reliability will substantially improve the combat capability and reduce the support costs of the F-111 and any other fighter aircraft it is applied to. Another high leverage R&M effort planned for FY 1988 is the insertion of VHSIC and Gallium Arsenide technologies into our Alaskan based SEEK IGLOO Minimally Attended Radars. The payoff from this effort will be a 300% improvement in system reliability which in turn will significantly improve readiness while reducing operations and support costs. In FY 1988, the Air Force also intends to transition developments in boron/epoxy, graphite/epoxy, and kevlar/epoxy repair patches. These repair patches have the advantage of arresting crack growth without the need for drilling new fastener

holes for a doubler and retarding stress corrosion cracks. This technology application offers great promise for improving the fatigue lives of the C-141 and C-130 while reducing depot repair times fivefold. Again, like the other R&M projects, the increases in readiness and supportability realized by this effort will be significant.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: As in FY 1987 and 1988, there are many possible high payoff R&M projects which are limited only by current funding constraints. One initiative the Air Force plans to undertake is to dramatically improve, by a factor of two orders of magnitude, the reliability and maintainability of electronic warfare (EW) systems through the use of various technologies to include Gallium Arsenide Monolithic Integrated Circuits for traveling wave tube (TWT) high power transmit active EW systems. This initiative will also substantially improve the reliability of the corresponding high voltage power supplies by incorporation of modular architectures and extensive built-in-test technologies. EW systems such as ALQ-131, ALQ-135, ALQ-99, ALQ-15! ALQ-189, etc., are candidates for this technology insertion. Spinoffs from this R&M effort are directly applicable to various high power fire control radars on fighter aircraft. Additional projects planned for FY 1989 include improvements to the reliability and maintainability of electronics in ground communications systems in the Cheyenne Mountain Complex and the Space Shuttle Orbiter. Both of these projects will provide better than a tenfold increase (from 300 hours to 4000 hours) in reliability and significant reductions in maintenance actions.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not Applicable

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64707F Title: Weather Systems
DOD Mission Area: 420 - Global Military Environmental Support Budget Activity: 6 - Defense-Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		7,638	8,163	12,537	11,769	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Program Element provides engineering development of weather systems that, when fielded, will eliminate critical shortfalls in weather support to Air Force and Army operations. The increasing emphasis on Air Force operations during night and bad weather makes the rapid and accurate determination of weather conditions of increasing importance. Requirements for improved weather support have expanded much faster than the capabilities to support them. This program provides several efforts to upgrade weather support to meet these requirements. Efforts include development of equipment to process, display, and disseminate weather data and forecasts to fixed-base and tactical weather stations; development of a Doppler weather radar; and development of the capability to support electro-optical weapon systems on the battlefield. The following efforts are included: (a) Through existing technology in minicomputers, displays, and communications equipment, the development and fielding of the Automated Weather Distribution System (AWDS) will partially automate Air Force weather stations around the world to significantly improve timeliness and accuracy of weather intelligence; (b) Development of the joint Department of Defense, Department of Commerce, and Department of Transportation Doppler weather radar called the Next Generation Weather Radar (NEXRAD) will, for the first time, allow direct measurement of winds within storm systems. Such capability is vital to forecasting tornadoes, damaging winds, and damaging hail. NEXRAD will dramatically increase our severe weather warning capability; (c) In the past, weather support to combat operations has emphasized those weather parameters sensible to man. Many current and developing electro-optical weapon systems are affected by weather in totally different ways than man, i.e., visibility for a human could be unlimited, yet an infrared sensor would not lock onto a target unless it can detect a target temperature different than its background. Conversely, infrared sensors work well at night when people can see nothing. This program provides engineering development of the Battlefield Weather Observation and Forecast System, a capability to measure critical weather elements in enemy territories and the capability of translating these data into meaningful support to electro-optical weapon systems.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	7,872	8,444	8,187	N/A	Continuing	N/A

EXPLANATION (U) Additional funds are provided in FY 1988 to accelerate the engineering development of NEXRAD and AWDS preplanned product improvements.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Other Procurement (PE 35111F):						
NEXRAD						
Funds	0	25,195	28,509	26,391	114,225	194,320
Complete Radar Quantities	0	5	7	7	25	44
User Set Quantities	0	3	26	22	52	103
AWDS Executive Subsystem						
Funds	0	0	16,600	33,602	80,521	130,723
Fixed Base Quantities	0	0	22	40	102	164
Transportable Quantities	0	0	0	6	13	19

5. (U) RELATED ACTIVITIES: PE 63707F, Weather Systems (Advanced Development), accomplishes advanced development projects whose results support PE 64707F. Funds for procurement of systems developed in PE 64707F are included in PE 35111F, Weather Services. The Next Generation Weather Radar (NEXRAD) is a joint Department of Commerce (DOC), Department of Defense (DOD) and Department of Transportation (DOT) development program. Development costs are shared: DOC - 60%, DOD - 20%, DOT - 20%.

6. (U) WORK PERFORMED BY: Automated Weather Distribution System (AWDS) development is managed by Electronic Systems Division, Hanscom Air Force Base, MA. The prime contractor is the Canadian Commercial Corporation, Ottawa, Canada. MacDonald, Dettwiler & Associates, Ltd, Richmond, British Columbia, Canada is the prime subcontractor. Development of the NEXRAD is managed by the Joint System Program Office within the National Weather Service, National Oceanic and Atmospheric Administration, Department of Commerce. Contractors are Raytheon Co., Wayland, MA, and Sperry Corporation, Defense Electronics, Great Neck, NY.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 64707F, Weather Systems (Engineering Development)

A. (U) Project Description: The increasing emphasis on Air Force operations during night and bad weather makes the rapid and accurate determination of weather conditions of increasing importance. This project funds development of equipment and techniques for a badly needed upgrade of Air Force Air Weather Service support. Such

support will make weather intelligence a force multiplier on the battlefield and will provide improved resource protection through greatly improved severe storm detection and warning. The following areas are addressed: (1) The Automated Weather Distribution System (AWDS) will automate most weather data handling tasks within each Air Weather Service weather station at major Air Force bases, some Army installations, and Air Force tactical facilities. It will replace 1950's technology equipment currently in use. AWDS will use a minicomputer to accelerate data handling, incorporate more efficient forecast preparation techniques, and speed dissemination of precise and up-to-date weather intelligence. Once observations, forecasts, and weather warnings become available, the system will display them to the forecasters and local users. A unique aspect of AWDS is its development through the Joint United States-Canada Production and Development Sharing Program. As such, the Canadian Government is funding half of the development contract. (2) The Next Generation Weather Radar (NEXRAD), a joint Departments of Defense/Commerce/Transportation development and procurement effort, will provide a greatly improved storm detection and warning capability. This radar will detect severe surface wind, hail, tornadoes and turbulence using Doppler techniques; automate thunderstorm tracking; accelerate severe thunderstorm identification; and improve warning accuracy and timeliness through use of interactive warning preparation techniques. It will double radar detection of severe thunderstorms, cut the severe thunderstorm warning false alarm rate from 75 percent to 25 percent and increase tornado touchdown warning time from an average of 0 minutes to 20 minutes. (3) The Battlefield Weather Observation and Forecast System (BWOFS) is beginning engineering development and continuing advanced development. The advanced development effort validates the forecasting techniques and provides operational weather units a rudimentary battlefield capability to support electro-optical weapons systems with slow, labor intensive techniques. The engineering development program develops the capability to collect critical weather data from behind enemy lines using the Unmanned Air Reconnaissance System and develops automated weather forecast techniques specifically tailored to the electro-optical weapons systems. This will vastly increase timeliness and accuracy of weather support to Air Force combat operations involving the employment of electro-optical weapon systems.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: AWDS: Software and hardware development and integration continued. Development Test and Evaluation (DT&E) began. NEXRAD: Prototype system development by both contractors continued. DT&E was conducted. The first phase of Initial Operational Test and Evaluation (IOT&E) began. BWOFS: Specification for the Tactical Decision Aid system began.

(2) (U) FY 1987 Program: AWDS: Software and hardware development and integration will be completed. IOT&E of the fixed base and transportable prototypes will be conducted. AWDS-Automated Observation Subsystem: Specifications for the integration of existing, digital weather sensors, e.g., wind, temperature and pressure, will be determined. NEXRAD: The initial phase of IOT&E will be completed. The source selection decision will be made and a limited production contract awarded. Final phase of IOT&E will begin after the source selected prototype is shipped to and installed at Norman, OK. BWOFS: Specifications for Tactical Decision Aid software for tactical command and control systems to provide weather forecasts tailored to specific weapons on the battlefield will be completed. The request for proposals for the Full Scale Development of this forecast system will be issued.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Automated Weather Distribution System (AWDS): Specifications for a preplanned, interoperable capability between AWDS and other command and control systems and a base-wide distribution capability for graphics displays will be prepared and full scale development will begin. AWDS-Automated Observation Subsystem (AOS): Specifications will be completed and the request for proposals for the integration of existing, digital weather sensors, e.g., wind, temperature and pressure sensors, a lightning sensor, and a present weather identifier will be prepared and issued. Next Generation Weather Radar (NEXRAD): Preplanned product improvements and deficiency corrections (as identified in IOT&E) will be integrated into the system. Battlefield Weather Observation and Forecast System (BWOFS): Tactical Decision Aid (TDA) software for battlefield weapons will be developed and integrated into Tactical Air Force command and control systems. Specifications for the Unmanned Air Reconnaissance System weather sensor will be prepared and the request for proposals issued. The funding request is based on awarded, ongoing contracts, contractor proposals, or contractor estimates. The confidence in the cost estimates ranges from Comprehensive (Level I) to Budget (Level III) depending on the maturity of the individual effort. Last comprehensive review of the cost estimate was completed in July 1986.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: AWDS: Full Scale Development of preplanned product improvements will continue. The initial improvements will include an interoperable capability between AWDS and other command and control systems and a base-wide distribution capability for graphics displays. AWDS-AOS: Full Scale Development for the integration of the initial suite of digital sensors--temperature, pressure, wind, lightning, and present weather--will begin. The automated weather observation capability will provide more timely distribution of weather data to forecasters and other operational users. BWOFS: TDA development will continue. Development Test and Evaluation of the automated composite TDA will be conducted. Full Scale Development of the weather sensor for the Unmanned Air Reconnaissance System will begin. This capability will provide critical weather data from enemy controlled and uncontrolled battle areas to key decision makers. The funding request is based on awarded, ongoing contracts, contractor proposals, or contractor estimates. The confidence in the cost estimates ranges from Comprehensive (Level I) to Budget (Level III) depending on the maturity of the individual effort. Last comprehensive review of the cost estimate was completed in July 1986.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones:

Milestones	Dates
(1) (U) NEXRAD Request for Proposal for Prototype Development	October 1982
(2) (U) AWDS Request for Proposal for Prototype Development	February 1983
(3) (U) NEXRAD Development Contract Award	June 1983
(4) (U) AWDS Development Contract Award	March 1984
(5) (U) NEXRAD Initial Operational Test and Evaluation Start	August 1986

Program Element: 64707F Title: Weather Systems
DOD Mission Area: 420 - Global Military Environmental Support Budget Activity: 6 - Defense-Wide Mission Support

		Milestones		Dates
(6)	(U)	AWDS Initial Operational Test and Evaluation Start		June 1987
(7)	(U)	Battlefield Weather Forecast System Development Contract Award	*(FY 1987)	December 1987
(8)	(U)	AWDS Preplanned Product Improvements Development Start		May 1988
(9)	(U)	AWDS-Automated Observation Subsystem Development Contract Award		January 1989
(10)	(U)	Battlefield Weather Observation System Development Contract Award		February 1989
(11)	(U)	AWDS Initial Operation		July 1989
(12)	(U)	NEXRAD Initial Operation (for the Department of Defense)		September 1989
(13)	(U)	Battlefield Weather Forecast System Initial Operation		4th Quarter FY 1991

* Data presented in FY 1987 Descriptive Summary

(U) Explanation of Milestone Change

(7) (U) Contract award slipped 6 months because Congress reduced the FY 1986 funding by $5.0 million. This reduction slipped some Automated Weather Distribution System (AWDS) FY 1986 development tasks into FY 1987; consequently funds originally programmed for the FY 1987 start of Tactical Decision Aid development will be used to complete the AWDS development.

9. (U) COOPERATIVE AGREEMENTS: AWDS Full Scale Development (FY 1984 - FY 1987) was accomplished through the Joint United States - Canada Production and Development Sharing Program. Through this program, the Canadian government funded half ($14 million) of the development contract. The prime contractor is Canadian Commercial Corporation, Ottawa, Canada. MacDonald, Dettwiler & Associates, Ltd, Richmond, British Columbia, Canada is the major subcontractor.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64735F
DOD Mission Area: 454 - Other Test and Evaluation Support

Title: Range Improvement
Budget Activity: 6 - Defense-Wide Mission Support

1. (U) RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		50,196	59,562	69,560	46,603	Continuing	N/A
2152	Mission/Engineering Support	4,700	4,700	4,612	4,698	Continuing	N/A
2286	Tactical Air Forces Range Equipment	6,596	6,092	14,200	6,600	Continuing	N/A
3319*	On-Board Electronic Warfare System	5,400	N/A	N/A	N/A	N/A	N/A
3320	Strategic Air Command Range Equipment	2,000	5,965	10,200	12,800	Continuing	N/A
3321	Airborne Radar Electronic Counter-Countermeasures	500	1,931	2,010	2,130	Continuing	N/A
6510	Flight Test Threat Systems Simulators	31,000	40,874	38,538	20,375	Continuing	N/A

* Project 3319 transferred to PE 64739F in FY 1987.

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Wartime experience has shown that a disproportionate number of combat losses occur during an aircrew's first ten combat missions. There is a continuing requirement to reduce those potential losses by more realistic weapon system testing, aircrew training and tactics development. The increasing cost of operating modern weapon systems also mandates that we attain the most effective use of our test and training resources. The Range Improvement Program contributes to the qualitative improvement of our combat forces by developing instrumentation and air defense threat simulator systems to increase the effectiveness of development and operational testing, training, and large scale exercises.

Program Element: 64735F
DOD Mission Area: 454 - Other Test and Evaluation Support

Title: Range Improvement
Budget Activity: 6 - Defense-Wide Mission Support

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
RDT&E	52,624	61,620	73,857	N/A	Continuing	N/A
Aircraft Procurement (PE 27429F)	18,100	7,900	26,600	N/A	Continuing	N/A
Other Procurement (PE 27429F)	56,573	64,221	68,976	N/A	Continuing	N/A
Other Procurement (PE 11879F):	27,779	66,369	93,648	N/A	Continuing	N/A

EXPLANATION: (U) The FY 1987 program reduction reflects the FY 1987 Appropriations Act. The FY 1988 program adjustments reflect a reprioritization of Air Force programs and new fiscal guidance. The remaining program adjustments reflect an emphasis on threat simulator research and development to field advanced threat systems in response to recent Soviet advances in air defense. As a result of this emphasis, procurement funds have been converted to R&D funds.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

Aircraft Procurement (PE 27429F):						
Funds	16,900	7,656	21,000	17,000	Continuing	N/A
Quantity	Not Applicable					
Aircraft Procurement (PE 11897F):						
Funds	0	0	0	5,000	Continuing	N/A
Quantity	Not Applicable					
Other Procurement (PE 27429F):						
Funds	58,765	39,293	55,868	69,035	Continuing	N/A
Quantity	Not Applicable					
Other Procurement (PE 11897F):						
Funds	41,414	94,244	95,314	121,468	Continuing	N/A
Quantity	Not Applicable					

5. (U) RELATED ACTIVITIES: Not Applicable.

6. (U) WORK PERFORMED BY: This program is managed by the Armament Division, Eglin AFB, FL. Major contractors include General Dynamics Corporation, Ft. Worth, TX (AN/MST-T1A - Multiple Threat Emitter System); Metric Corporation, Ft. Walton Beach, FL (AN/MPQ-T3 - Multiple Threat Emitter); Martin-Marietta, Denver, CO (AN/MSR-T4 - Electronic Warfare Signal Analyzer); Cubic Corporation, San Diego, CA (Air Combat Maneuvering Instrumentation System); and American Electronics Laboratories, Lansdale, PA (AN/MLQ-T4 - Ground Jammer). There are 20 additional contractors and $48.5 million in additional contracts.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 2152, Mission/Engineering Support. This project provides the basic operating funds, system software acquisition, and systems engineering support for the Range Improvement Program. Basic operating support includes temporary duty costs, equipment and supplies. System software acquisition provides research and development funds for project software development. Systems engineering support provides technical evaluations, documentation and development tasks to improve the simulated operational threat environment, and the instrumentation and range support equipment. Most of this effort is currently being accomplished by a systems engineering and technical assistance (SETA) contractor, VSE Corporation, Ft Walton Beach, FL. FY 1986 funds provided range and system safety analyses, computer and cost estimating support, funding for travel, training, supplies, equipment, as well as the basic operating capital for the Range Improvement Program. The SETA contractor conducted engineering, management, and related studies; developed assessments and analyses; performed systems engineering; formulated specifications; wrote statements of work; and performed related work to accomplish these tasks. In FY 1987, the project will continue to provide range and system safety analyses, computer support, cost estimating support, travel, training, supplies and basic operating capital for the program. The SETA contractor will provide continuing engineering support, conduct studies, and perform assessments and analyses. The FY 1988 and FY 1989 effort will continue to provide the basic operating funds, system software acquisition and systems engineering support for the Range Improvement Program.

B. (U) Project: 3321, Airborne Radar Electronic Counter-Countermeasures (ECCM). This project provides upgrades and improvements to the radar test facility at Tyndall AFB to provide a capability to support airborne radar/weapon system ECCM engineering design, development and test programs. FY 1986 funds began the development of an APG-70 radar (F-15) test bench. FY 1987 and FY 1988 funding will complete this effort as well as begin development of an APG-68 radar (F-16) test bench. FY 1989 funding will continue the effort.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2286, Tactical Air Forces (TAF) Range Equipment

A. (U) Project Description: This project provides for the development and procurement of various electronic, telecommunications and instrumentation equipment and systems for the tactical operational test and training ranges

worldwide. This equipment will enhance range capability by more realistically simulating the combat environment and providing more accurate data for training, testing and evaluation to enhance aircrew training and combat readiness. The project develops both high fidelity replicas and signal emitter systems designed to simulate enemy air defense radar systems (e.g., surface-to-air missile and anti-aircraft artillery gun target tracking and fire control radars, early warning, search, acquisition and height finding radar systems). It also develops equipment designed to simulate ground-based radar jamming systems as well as enemy air defense command and control systems. The project also provides for studies and development efforts to acquire new range and instrumentation systems designed to observe, collect, measure, track, record and control aircraft and systems under test; systems to relay voice, aircraft and missile telemetry data; computer-based systems for range command, control and communications data processing as well as other functional systems/subsystems which support test and training activities on operational test, evaluation and training ranges.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: FY 1986 funds completed the Range Control Aircraft (Airborne Platform/Telemetry Relay System) software development. Funds were used to continue improvement of Air Combat Manuevering Instrumentation (ACMI)/aircraft interfaces and to evaluate the use of the Global Positioning System (GPS) on ACMI ranges and GPS integration with the Tyndall AFB drone control system. The AN/MPQ-T3 simulator modification design was completed. Design/development of the Missile End Game Scoring (MEGS) System for the Gulf Range began. Development began on a new Modular Advanced Threat Emitter System (MATS) and the AN/TPS-T2 emitter-receiver-processor radar simulator.

(2) (U) FY 1987 Program: FY 1987 funds will be used to continue development of the Gulf Range MEGS system. Development efforts will continue on MATS and ACMI enhancements. Work will begin on improvements to the Unmanned Threat Emitter System. Additionally, development work will begin on software development for a Homestead AFB, FL, ACMI system, a Laser Engagement System (LES) for A-10 aircraft supporting US Army exercises at the National Training Center, Ft Irwin, CA, and software upgrades to the Red Flag Measurement and Debriefing System (RFMDS) located at the Nellis AFB, NV.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: FY 1988 funds will be used to continue development of MATS and the Homestead ACMI, to start development of the Crow Valley Measurement and Debriefing System (CVMDS), drone control system for the Pacific Air Command, and to continue the design effort for the LES and software upgrade for the RFMDS.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: FY 1989 funds will continue the development of the MATS, ACMI enhancements and software upgrades to the RFMDS.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not Applicable.

9. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3320, Strategic Air Command (SAC) Range Equipment

A. (U) Project Description: This project provides the same type of range equipment, instrumentation, training emitter systems, etc., for SAC training ranges as does project 2286 for the tactical forces. The primary effort supports the development of a new Strategic Training Route Complex (STRC) for strategic bomber crew training and the development of the emitter system equipment to be used on the STRC to create a more realistic combat environment. The STRC will be a system of interlocking, low-level navigation routes with scored bomb legs. The range will be equipped with simulated enemy threat air defense systems (i.e., air defense radars and ground jammers) with measurement systems (signal analyzers) to record crew/aircraft performance for no-drop bomb scoring, mission debriefing and training feedback. The range will also provide equipment performance evaluation. The STRC Route Integration Instrumentation Systems (RIIS) will collect and transmit STRC range data via microwave, landlines, and/or satellite to a central facility, the Strategic Training Center, for processing, formatting, and display.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: FY 1986 funds were used to continue development of the new STRC/RIIS.

(2) FY 1987 Program: FY 1987 funding will continue STRC/RIIS development and begin development of an electronic combat training data recorder for the B-1B aircraft to allow EC data recording on B-1B STRC training sorties.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: FY 1988 funds will continue STRC/RIIS development and threat updates to the AN/MST-T1 emitter systems, continue B-1B electronic combat (EC) recorder development, and initiate performance enhancements to the AN/MSR-T4 threat receiver/analyzer system.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: FY 1989 funding will continue recorder and STRC development efforts, AN/MST-T1A and AN/MSR-T4 improvements as well as begin STRC initial operational test and evaluation planning.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not applicable.

Program Element: 64735F Title: Range Improvement
DOD Mission Area: 454 - Other Test and Evaluation Support Budget Activity: 6 - Defense-Wide Mission Support

10. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 6510, Flight Test Simulators

A. (U) Project Description: This project funds the development of test quality replicas of Soviet air defense radar equipment. The equipment will be used in flight testing our new aircraft radars and avionics systems's electronic warfare capability. This project fills a continuing and expanding need to flight test and evaluate new, and newly modified, electronic combat (EC) equipment prior to production. To be effective, this testing must be conducted in an environment which accurately simulates the EC environment to include enemy threat radar simulators. In the past, the adaptability of airborne electronic countermeasure (ECM) systems was quite limited; however, new radar warning receiver signal processing technology and techniques and smart jamming systems are highly adaptive and allow ECM system flexibility. It is extremely difficult to construct a creditable test for such ECM equipment without a large number of different instrumented threat systems to cover the entire threat spectrum.

B. (U) Program Accomplishments and Future Efforts:

(1) FY 1986 Accomplishments: FY 1986 efforts included several simulators of Soviet threat radar systems: the simulator software development, integration and testing was completed; continued development of the and other simulator modifications; continued full scale development of the and and continued the effort to incorporate a capability into the Flycatcher radar,

(2) FY 1987 Program: FY 1987 funds will continue development work on the and Flycatcher radar enhancements. Full scale development will continue on the and missile seeker system. Contract definitization will be completed for a second HAVE PEWTER system. Work will continue on the development of the HAVE COPPER radar simulator. Development will begin on a new airborne reference radar system and a new threat command, control and communication simulator.

(3) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: FY 1988 funds will continue development work on the HAVE PEWTER and HAVE COPPER missile systems. Work will also continue on the SARS-VI, and simulator modifications. Enhancements to the Flycatcher system will be completed. Development will begin on the

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: FY 1989 funds will continue development work on the HAVE PEWTER, HAVE COPPER, and HAVE IRON threat radar simulators. Work will also continue to develop the airborne reference radar as well as to continue intelligence updates and modifications to existing threat simulators.

Program Element: 64735F
DOD Mission Area: 454 - Other Test and Evaluation Support

Title: Range Improvement
Budget Activity: 6 - Defense-Wide Mission Support

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not Applicable.

11. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64747F
DOD Mission Area: 454 - Other Test & Evaluation Support

Title: Electromagnetic Radiation (EMR) Test Facilities
Budget Activity: 6 - Defense-Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands):

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	3,356	5,496	5,942	6,238	Continuing	N/A
1209	Nuclear Effects Simulation Test Facilities	2,161	4,397	4,754	4,990	Continuing	N/A
2064	HAVE NOTE	1,195	1,099	1,188	1,248	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Nuclear weapon detonations generate electromagnetic pulses (EMP) which can damage electronic components. Nonnuclear electromagnetic emissions such as jamming may also cause component damage. The equipment malfunctions resulting from these electromagnetic environments can cause a significant reduction in weapon system effectiveness. This program element funds the operation, maintenance, and improvement of test facilities used by weapon system program offices to determine the ability of their systems to operate in nuclear (Project 1209) and nonnuclear (Project 2064) electromagnetic environments. Users of these facilities pay the actual costs of their specific tests. Under Project 2064, hardness criteria for nonnuclear electromagnetic effects are also developed for incorporation by users into aerospace weapon system design specifications and standards.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands):

RDT&E	3,290	5,686	6,268	N/A	Continuing	N/A

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: Project 1209, Nuclear Effects Simulation Test Facilities, is related to Program Element 64711F, Systems Survivability (Nuclear Effects). Work performed under Program Element 64711F develops techniques for the vulnerability assessment, testing, and hardening of weapon systems to all nuclear effects, while Project 1209 implements a testing capability for one specific nuclear effect, EMP. The Air Force Weapons Laboratory is responsible for coordinating these efforts. Project 2064 (HAVE NOTE) is the Air Force implementation of the Special Electromagnetic Interference Project, an initiative of the Office of the Under Secretary of Defense for Research & Engineering, which directs all three services to test their air-launched weapons for electromagnetic interference and to share test results and conclusions. Tri-service reviews are held periodically. Beginning in FY 1986, HAVE NOTE supports research in the

area of system/component vulnerability to high-power microwave radiation, which is funded under Program Elements 62601F, Advanced Weapons, and (beginning in FY 1988) 63605F, Advanced Radiation Techniques.

6. (U) WORK PERFORMED BY: Project 1209 is managed by Air Force Systems Command (AFSC) through the Air Force Weapons Laboratory (AFWL), Kirtland Air Force Base, NM. BDM International, Inc., McLean, VA, is the facilities support contractor. Project 2064 is managed by AFSC through Rome Air Development Center (RADC), Griffiss Air Force Base, NY. The test support contractor is Rome Research Corp., New Hartford, NY. RADC also has contracts with Advanced Electromagnetics, Albuquerque, NM, and the University of Colorado, Colorado Springs, CO, for methodology development efforts.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 1209, Nuclear Effects Simulation Test Facilities. This program is for development, acquisition, and baseline support of test facilities which simulate the nuclear electromagnetic environments in which weapon systems may be required to operate. The principal nuclear simulation facilities are the vertically and horizontally polarized electromagnetic pulse (EMP) dipoles and the in-flight EMP simulation facility (TRESTLE). These facilities are used to test aircraft and missile systems. The AFWL/Los Alamos Electromagnetic Calibration and Simulation Facility, a high-level, bounded-wave simulator of comparatively small volume, is used to test small missiles and communications equipment. Additional capabilities include portable EMP generators for remote site tests and a laboratory used for testing of individual electronic components. In FY 1986, AFWL evaluated the EC-135 aircraft for the Worldwide Airborne Command Post System Program Office, the Electronic Switching System and the D-4 Channel Bank for National Communications Systems, Regency Net for the Army, the Sidearm missile for the Navy, a French Astarte command post aircraft (sponsored by Naval Air Systems Command), and the Air Force Satellite Communication System and the Commander-in-Chief Residence Communication System for Strategic Air Command. Technology efforts are also funded under this program element. They include support to the EMP Test Aircraft (EMPTAC)--which is an AFWL testbed for a variety of technology projects in the area of EMP hardness design, maintenance, and surveillance--and improvements in analysis techniques and test technology. For example, AFWL began a major upgrade of the data acquisition and processing systems, required for the FY 1988 B-1B test, in FY 1986. In FY 1987, evaluation of the Astarte will continue. Other systems scheduled for evaluation are the TORNADO aircraft for Defense Nuclear Agency (DNA), the HIS-2 (VH-3) Helicopter (retest) for the Naval Air Development Center, and the UH-60A Blackhawk helicopter (retest) for the Army and Defense Nuclear Agency. Also in FY 1987, AFWL will begin detailed planning for the FY 1988 B-1B test. In addition, the Laboratory will continue to support the EMPTAC and other technology programs, and continue the upgrade of the data acquisition and processing systems. This upgrade will be completed in FY 1988. Subsequently, the B-1B will be tested on both the Horizontally and Vertically Polarized Dipoles as well as on the TRESTLE Facility. Other systems scheduled to be tested in FY 1988 are the EC-135 aircraft and the Small Intercontinental Ballistic Missile (ICBM) Hard Mobile Launcher for the Air Force, the OH-58C Helicopter for the Army, and the E-6A aircraft for the Navy. A second Astarte aircraft will be tested. Support to the EMPTAC and other technology programs will continue. In FY 1989, AFWL will continue testing of the Small ICBM Hard Mobile Launcher, test a third Astarte aircraft, and begin testing of both the C/EC-17 and KC-135 for the Air Force. Support to EMPTAC and other technology programs will continue. The estimated costs are based on past program experience, adjustments for expected cost growth, and the workload projected to support the above projects. The

requirement to test weapons systems for survivability to EMP is continuing.

B. (U) Project: 2064, HAVE NOTE. This program is for development, acquisition, and support of test facilities which simulate the nonnuclear electromagnetic environments in which weapon and command, control and communication (C^3) systems must be able to operate. Air-launched weapons and C^3 systems are tested in these facilities to assess their susceptibility to nonnuclear electromagnetic radiation (EMR) from hostile or friendly sources such as radios, radars, jammers, or other electronic devices. For periods of time comparable to the duration of a mission, these facilities can illuminate the weapon with a replica of environments it may encounter in flight. The principal nonnuclear test facility is the Electromagnetic Compatibility Analysis Facility (EMCAF), an anechoic chamber where air-launched weapons can be radiated by a variety of signals. In addition to its primary use in characterizing system susceptibility, the test data is also used to update test methods, acquisition specifications, design standards, and maintenance technical orders to ensure that the weapon system is immune to those radio frequency emanations which it may encounter during its life cycle. In FY 1986, Rome Air Development Center (RADC) completed an evaluation begun the previous year of the Low-Level Laser Guided Bomb and did a quick-look assessment of the DSU/33B Proximity Fuzes. The EMR testing of the Advanced Medium Range Air-to-Air Missile (AMRAAM) full-scale development (FSD) model began. Work on the Rapid-Evaluation Chamber, a new EMR test chamber begun in FY 1985, continued in FY 1986. The Rapid-Evaluation Chamber will be used to make quick surveys of test article responses before major testing and to support quick retesting after design modification of weapon systems. In FY 1986, RADC constructed the shielded enclosure for the chamber and purchased necessary components and instrumentation. In FY 1987, the evaluation of the AMRAAM FSD model will be completed, full EMR testing of the DSU/33B Proximity Fuze will be conducted, and the Imaging Infrared (IIR) Maverick will undergo high-power microwave (HPM) testing. RADC will complete the installation of the Rapid-Evaluation Chamber, and the National Bureau of Standards will begin characterization of the facility. The chamber will be activated for continuous wave testing by the end of the year. In FY 1988, RADC will complete HPM testing of the IIR Maverick and conduct EMR testing of the AGM-130 (powered version of the GBU-15 Glide Bomb). The Center will complete test planning for the AGM-130 Improved Data Link and the Sensor-Fuzed Weapon, and will begin actual testing. Initial operational capability of the Rapid-Evaluation Chamber will be achieved, following the completion of facility characterization. RADC will continue facility upgrades of the EMCAF to attain an improved vulnerability assessment capability against new or projected threats, including HPM. Facility upgrades, to meet special, rapid-sequence test requirements for advanced weapon systems with operating time limitations, will continue. RADC will upgrade test methodologies and data bases for expected EMR environments to keep pace with new test requirements and the advancing threat. In FY 1989, testing of the Improved Data Link and Sensor-Fuzed Weapon will continue, and initial EMR assessments for the AMRAAM Product Enhancement Program will begin. Facility upgrades and characterization of the Rapid-Evaluation Chamber will continue. The testing of weapon systems for survivability in nonnuclear electromagnetic environments is a continuing requirement. The estimated costs are based on past program experience, adjustments for expected cost growth, and the workload to support the above projects.

8. (U) PROJECTS OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 64755F
DOD Mission Area: 451 - Major Ranges and Test Facilities

Title: Improved Capability for DT&E
Budget Activity: 6 - Defense-Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		43,179	73,227	64,663	71,257	Continuing	N/A
2871	Global Positioning System/Time-Space Position Information (GPS/TSPI)	11,655	22,519	0	0	0	45,293
2880	4950th Test Wing	15,479	20,307	10,656	4,308	Continuing	N/A
3120	Armament Division	5,193	10,863	14,383	19,413	Continuing	N/A
3285	Arnold Engineering & Development Center (AEDC)	1,889	2,539	2,390	2,979	Continuing	N/A
3323	Cruise Missile Mission Control Aircraft (CMMCA)	282	5,277	14,600	19,000	15,241	54,400
3324	HAVE LINK	0	2,000	4,912	9,466	Continuing	N/A
3620	Air Force Flight Test Center (AFFTC)	8,681	9,749	17,722	16,091	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides the system upgrades and new systems required to adequately test and evaluate weapon and support systems in development. The program includes the engineering, development, acquisition and installation of significant new test range and instrumentation systems required to insure that the Department of Defense (DOD) Major Range and Test Facilities Base (MRTFB) test and evaluation technology is compatible with the systems it is required to test. The MRTFB is a national asset which is operated and maintained primarily for DOD test and evaluation missions, but is also available to other users having a requirement for its unique capabilities. Test facilities improvements funded within this program include improvements to wind tunnels, rocket test cells, space chambers, armament ranges, climatic test facilities, avionics test facilities, and extensive instrumented ranges. Test and evaluation support is provided to the Air Force, other Services, government agencies, commercial industry, and foreign customers.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	45,234	89,518	78,256	N/A	Continuing	N/A

Program Element: 64755F | Title: Improved Capability for DT&E
DOD Mission Area: 451 - Major Ranges and Test Facilities | Budget Activity: 6 - Defense-wide Mission Support

EXPLANATION: (U) The current funding level reflects FY 87 Congressional reductions and current OSD fiscal guidance. This program has been restructured for more effective management control of the tasks assigned to the Major Range and Test Facilities Base activities for execution.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: The Improved Capability for DT&E program supports the Test and Evaluation Support Program (PE 65807F) since most PE 64755F projects were originally contained within PE 65807F. PE 64755F contains funding for high priority range support projects. Prototype and low rate intial production of Global Positioning System/ Time-Space Postioning Information equipment is contained within PE 64940D, Test Instrumentation Development. In addition, the improved capabilities benefit all weapon systems test programs which come to the ranges and centers.

6. (U) WORK PERFORMED BY: The improvement and modernization projects contained in this program are the responsibility of the applicable range/center/product division. These Air Force organizations are Arnold Engineering and Development Center (Arnold AFS, TN), Armament Division (Eglin AFB, FL), Air Force Flight Test Center (AFFTC) (Edwards AFB, CA), and 4950th Test Wing (Wright-Patterson AFB, OH). Major contractors and associated projects are: Applied Physics Laboratory/Johns Hopkins University, Laurel, MD (Sonobuoy Missile Impact Location System); E-Systems, Greenville, TX (Advanced Range Instrumentation Aircraft--sonobuoy launch system only); Computer Science Corporation, Lompoc, CA (Integrated Facility for Avionics Systems Test); VERAC Incorporated, San Diego, CA (Advanced Range Data System); and Southern Research Incorporated, Birmingham, AL (Seeker Development).

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 2871 - Global Positioning System/Time-Space Position Information (GPS/TSPI): The GPS/TSPI Program developes range applications of GPS technology for Air Force, Army, and Navy test and training ranges. GPS technology will improve TSPI accuracy and coverage, reduce the number of ground-based tracking sites, and enhance inter-range compatibility. The objective is to miniaturize and configure GPS receivers and translators to interface with host test and training vehicles and accommodate stringent data requirements. Production of prototype range equipment, system acceptance testing, and operational test and evaluation are scheduled through FY 1988. Prototype and low rate intial production equipment is contained within PE 64940D, Test Instrumentation Development.

B. (U) Project: 3280, Arnold Engineering and Development Center (AEDC): AEDC, Arnold AFS, TN, provides ground environmental test support for Air Force aeronautical, missile and space programs as well as other DOD agencies, government agencies and industry programs, The center has three facilities comprised of wind tunnels, altitude rocket and turbine cells, arc heaters, aeroballistic ranges, space chambers plus administrative and technical support facilities. The test facilities are: Von Karman Gas Dynamic Facility (VKF) which performs aerodynamic testing of scale model aircraft, missile and space systems from Mach 1.5 to 10.0, testing of large and full-scale satellites, sensors and space vehicles in a simulated space environment and projectiles (both high performance and conventional guns) at various altitudes and reentry conditions; Engine Test Facility which provides altitude environmental testing for aircraft, missile and spacecraft propulsion systems including turbojets, turbofans, and both liquid and solid propellant rockets; and Propulsion Wind Tunnel Facility (PWT) which provides testing of large-scale models, and in some cases, full scale engine inlet combinations, missiles and space boosters together with their propulsion systems at Mach numbers from 0.5

) 4.5. The Center also supports programs of the National Aeronautics and Space Administration (NASA), such as Space ransportation System, the Army Ballistic Missile Division and the Navy, as well as technology support to the Department f Energy. The Center's facilities are national assets that provide unique test capabilities not available elsewhere. nprovement and Modernization efforts for Arnold Engineering and Development Center (AEDC) keep these unique test apabilities abreast of the weapon system technology currently under test. In FY 1988, phase three of the AEDC Computer nhancement Program will continue to provide real-time data processing and state-of-the-art capabilities. Plant itomation for the basic and additional refrigeration controllers in Environmental Test Facility will be installed. ynamic data acquisition systems will be procured to provide capability to support dual cell concurrent operations and educe cell turnaround time. Test Area Control systems in the turbine cells will be activated and validated. FY 1989 rough FY 1992 project funding includes resources to manage the acquisition and activation of the new Large Rocket Test acility (J-6), which starts construction in FY 1989. The final phase of the Facility Computer Enhancement Program ccurs in FY 1989. Data system improvements, facility plant upgrades, and test article control improvements will ontinue to significantly enhance AEDC's testing capabilities.

C. (U) Project: 3324, HAVE LINK: The Air Force HAVE LINK program implements Office of the Secretary of Defense irection to protect weapons systems design information and test data on test ranges. The HAVE LINK program implements orrective measures to eliminate identified vulnerabilities subject to exploitation by hostile intelligence collection gencies. The FY 1987 program addresses the most urgent vulnerabilities, corresponding to information of high value and ollection at low risk to the collector. Project 3324 specifically addresses vulnerabilities at AEDC, Armament ivision (AD) Eglin AFB, FL, Air Force Flight Test Center (AFFTC) Edwards AFB, CA, and Aeronautical Systems Division ASD) Wright-Patterson AFB, OH. Implementation for the Eastern Space and Missile Center, the Western Space and Missile enter, Utah Test and Training Range, and 6585 Test Group is funded within PE 78022F, PE 78032F, PE 78019F, and PE 5708F respectively. HAVE LINK is a level of effort program. FY 1988 and FY 1989 funds will purchase equipment to ontinue efforts begun in FY 1987. Specifically, funds will support secure voice communications, telemetry encryption, ecure video, data and radio transmission equipment, and upgrades to existing facilities to meet TEMPEST requirements.

•. PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

Project: 2880, 4950th Test Wing (4950 TW)

A. Project Description: The 4950th Test Wing, Aeronautical Systems Division, Wright-Patterson AFB, OH, performs light tests of aircraft and airborne systems, supports space vehicle tracking for the Air Force Systems Command's AFSC) Space Division, other DOD agencies, and the National Aeronautics and Space Administration. The Wing has the apability to conduct full-scale engineering evaluations, airborne instrumentation and data reduction, flight test ircraft modification and extensive technical photo documentation. Staging out of 13 overseas bases, the Advanced Range Instrumentation Aircraft (ARIA) provides telemetry support for the National Aeronautics and Space Administration and DOD issile launches out of Cape Canaveral, FL, and Vandenberg AFB, CA. Improvement and modernization efforts include: ARIA Upgrade, Palletized Digital Avionics Recording Test System (PDARTS), Integrated Data Facility (IDF), and Computer Aided Engineering (CAE). ARIA upgrade is a continuing program to ensure support of test user requirements. The current program converts previously purchased C-18 (used Boeing-707/320) aircraft to the ARIA EC-18B configuration including upgrades of onboard data-processing equipment to meet the increased sensitivity and data rate requirements of the users. PDARTS will integrate and flight test software-intensive avionics systems, providing a capability to perform

fully instrumented, developmental flight test of digital avionics at the component level. The Integrated Data Facility (IDF) will consist of a ground-based laboratory module, a real-time test data monitoring module and a module for improved data computation and analysis. Computer Aided Engineering (CAE) is a tool used by engineers, designers, and Computer Numerically Controlled (CNC) Machine programmers to create, develop, and fabricate design. CAE provides intelligent design tools which incorporate expert systems technology, designs standards, specialized analysis programs, and geometric/physical property calculation capabilities. The Electronic Counter-Countermeasures (ECCM) Advanced Radar Testbed will provide an airborne platform to support design and testing of new and improved radar systems.

B. Program Accomplishments and Future Efforts:

(1) FY 1986 Accomplishments: The number two EC-18 which was partially modified to the Advanced Range Instrumentation Aircraft (ARIA) configuration received the prototype Sonobouy Missile Impact Location System (SMILS). The EC-18 conversion work on aircraft number three and four continued. An optics contract was awarded. Upgrades include expanding Palletized Digital Avionics Recording Test System (PDARTS) usage to C-130 aircraft, expanding to multiple MIL-STD-1553 data bus control and monitoring, improving navigation capability, and providing capability for on-pallet software development, simulation, and data reduction capability. Detailed planning efforts, development of system architecture, and installation of a VAX 11/785 computer system for IDF. CAE equipment purchases and planning efforts were completed.

(2) FY 1987 Program: The first article ARIA system will be fabricated, airworthness test and flight test plans will be developed and finalized, and inplant testing of the first article will begin. Production sonobuoy launch tubes and instrumentation will be installed during aircraft modification and optics development will continue. One EC-18B ARIA will roll out. PDARTS design will be completed. A study contract will be awarded to perform technical analysis of the IDF. CAE equipment purchases and planning efforts will continue.

(3) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: ARIA optics upgrades will include first article test and production delivery of optics kits. The meteorological effort will include completing the procurement of remaining instrumentation, perform sonde (weather measurement device) separation tests and systems flight testing, complete procurement package and contract award for production sondes. The fourth EC-18 to be coverted will begin operation. PDARTS development support, purchase of equipment, modification and flight testing integration and checkout will continue. IDF hardware acquisition commences. CAE major system purchase is planned. A multi-year competitive contract will be awarded in the first quarter of FY 1988 with system deliveries throughout FY 1990.

(4) FY 1989 Planned Program and Basis for FY 1989 RDT&E Program: The second EC-18 will receive the remainder of the ARIA modification after completion of the SMILS prototype testing and roll out in FY 1989. SMILS Launch tubes will be installed and instrumentation modifications will continue in FY 1989. PDARTS integration and checkout, IDF hardware acquisition, and CAE equipment procurement will continue. New capabilities will include the use of expert systems in structural design and analysis, electronic circuit simulation, integrated circuit design, and support of 5-axis CNC machining. Final system configuration will include 54 stand-alone CAE workstations, peripheral equipment, and a local area network to allow for the sharing of data and on-line storage of released engineering data.

(5) Program to Completion: This is a continuing program.

. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3120, Armament Division (AD)

A. (U) Project Description: AD is located at Eglin AFB, FL, and is responsible for Air Force nonnuclear armament development. AD, as the USAF focal point for munitions integration into aeronautical systems, conducts and supports USAF weapons effectiveness testing, electronic combat testing, electronics surveillance and control testing, and aeronautical systems testing. AD uses over 50 instrumented test areas, sites, and ranges, operates the McKinley Climatic Laboratory, and operates 41 aircraft of seven different types. Improvement and modernization efforts include: Seeker Development, Computer Sciences, Multipurpose Range Systems Upgrade, Armament Systems Test Environment (ASTE) Upgrade, and Airborne Radar Electronic Counter-Countermeasures (ECCM). Seeker Development provides laboratory, field, and airborne instrumentation to support development testing of precision guided weapons and aircraft systems. Computer Sciences includes acquisition of subsystems to improve and modernize the Eglin computer sciences facility. Multipurpose Range Systems Upgrade provides for upgrading Airborne Instrumentation and Multipurpose Instrumentation (MPI) systems to meet the test requirements of increasingly complex weapons systems. ASTE Upgrade provides for the modernization of the major data collection systems for weapons test missions to enhance the ability to define lethality and safe separation characteristics for aircraft cannon, rocket, and missile munitions. Airborne Radar ECCM provides the modernization of electronic jammers, associated software, and instrumentation required to furnish realistic electronic combat environments.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Seeker Development: A high temperature capability contract was awarded to develop the infrared (IR) algorithm test simulator. Computer Sciences: Ten display consoles were purchased to handle increasingly complex missions and provide real-time support for up to six simultaneous missions. These updates to real-time telemetry support help to achieve a "dual complex mission" capability and provide efficiently-processed, reliable test data. MPI Range Systems Upgrade: Considerable effort continued in range telemetry and microwave systems to provide the capability to conduct two complex Electronic Combat missions concurrently. Time-code generators, computer-aided design stations, and AIM-9 Camera Pods were procured. ASTE Upgrade: High speed video cameras, photo-optics, and cinetheodolites were upgraded. Expanded data collection systems were procured.

(2) (U) FY 1987 Program: Seeker Development: Expansion of seeker Development Test and Evaluation capability will continue with the Seeker Evaluation Test Simulation Facility (SETS) and the scenario range. Both the Infrared Algorithm Simulator and the Weapons Survivability Instrument System become operational in FY 1987, and major upgrades will take place in seeker vulnerability test capability to include countermeasures and obscurant systems. Computer Sciences: Procurement of advanced display equipment will continue in support of the Centralized Control Facility. Optical assessment equipment will be procured. Telemetry data reduction equipment will be upgraded. MPI Range Systems Upgrade: AIM-9 Camera Pod procurement will continue. Wideband data transmission systems (fiber optics systems) and support equipment purchases will be initiated. ASTE Range Systems: Video and remote control will be added to cinetheodolites, as well as computer-aided tracking capability. New cameras and an accelerometer calibration system will be installed on the range. An ECCM aircraft will be modified as a generic radar testbed, including nose cone, wave guide, an instrumentation suite.

Program Element: 64755F
DOD Mission Area: 451 - Major Ranges and Test Facilities

Title: Improved Capability for DT&E
Budget Activity: 6 - Defense-wide Mission Support

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Seeker Development: A rate table will be developed for the Guided Weapons Evaluation Facility (GWEF) which will accommodate a variety of guided seekers and point source targets. Computer Sciences: A major objective of the Armament Division is to develop the capability to execute two major missions simultaneously. The necessary computer hardware to support the required twelve-stream telemetry capability must be acquired in early FY 1988 in order to implement software needed to perform both range systems test and evaluation and operational real-time and post-mission data processing. Multipurpose Instrumentation (MPI) Range Systems Upgrade: The buildup of the range telemetry dual-mission capability will be continued. Upgrades of support systems including the sled track capability, radiometers, timing/video equipment and weather instrumentation will be accomplished. Replacements of unsupportable analog microwave (MW) systems with digital MW systems and replacement of over 300 single-channel, tube-type range radios with four-channel modern radios will also take place. Also to be upgraded are wideband data transmission equipment, weather sensors and test/calibration equipment and Infrared resolution test capability. The FY 1988 Preflight Integration of Munitions and Electronics Systems (PRIMES) facility will be upgraded with a second RF test unit and aircraft interface instrumentation required to test the critical directional power management features of Radar Warning Receiver Systems (RWRS). Armament Systems Test Environment (ASTE) Upgrade: Improvements will be made in the areas of cinetheodolites, range photo-optic cameras, high-speed video cameras, explosive instrumentation data systems, advanced warhead and fuze test systems, and laser trackers. Electronic Counter-Countermeasures (ECCM): Design and installation of test equipment on board a host C-141 aircraft will include operator stations, Line Replaceable Unit (LRU) test benches, generic test equipment, and interface equipment. Work also begins on the Armament Division electronic jammers and other range instrumentation such as radio frequency generators, receivers and supporting software.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Seeker Development: A Seeker Vulnerability Evaluation capability to test active infrared countermeasures will be procured in FY 1989 and a capability to test systems designed to detect and deactivate optical tracking systems will be started. Work will also begin to define the realistic level of countermeasure simulators, obscurant generators, and instrumentation required for the scenario ranges. Computer Sciences: Additional hardware will be acquired for secure real-time and post-flight data processing. Future efforts will continue acquisition of computer hardware for real-time mission analysis. MPI Range Systems Upgrade: Acquisition of computer hardware for real-time mission analysis will continue. ASTE Upgrade: Upgrade of cameras, high-speed video, explosive instrumentation data systems, advanced warhead and fuze test systems, and laser tracker improvements will continue. ECCM: FY 1989 efforts continue work begun in FY 1988.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not Applicable.

10. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3323, Cruise Missile Mission Control Aircraft (CMMCA)

A. (U) Project Description: The existing test support scenario for cruise missile testing requires a fleet of up to 17 aircraft to provide visual safety chase, telemetry collection and tanker support. Some cruise missile test missions also require Airborne Warning and Control System (AWACS) aircraft for radar flight following. This support

rogram Element: 64755F | Title: Improved Capability for DT&E
)OD Mission Area: 451 - Major Ranges and Test Facilities | Budget Activity: 6 - Defense-wide Mission Support

cenario is resource intensive and the visual safety chase precludes testing in other than visual meteorological flight onditions. The Cruise Missile Mission Control Aircraft (CMMCA) will consolidate telemetry support, mission control unctions, and radar safety chase and flight following capabilities for cruise missile testing into a single C-18 irborne platform. Consequently, the CMMCA will reduce the requirements for visual chase, Airborne Warning and Control ystem (AWACS) and tanker support, and will allow cruise missile testing in instrument meteorological conditions. lthough the CMMCA will replace visual safety chase for the majority of cruise missile test missions, developmental ruise missiles, and those containing classified payloads will still require a visual safety chase after launch. Two -18 aircraft currently in the Air Force inventory will be configured to be CMMCA and, when operational, will support pproximately 70 cruise missile test missions per year.

B. (U) Program Accomplishments and Efforts:

(1) (U) FY 1986 Accomplishments: The Concept Study Phase, to include cost and schedule validation, began in Y 1986. A Requirements Study Working Group was formed from the 4950th Test Wing and the user community in order to completely define operating requirements of the EC-18 CMMCA, which will form the foundation of the system pecification. ASD/AFY was selected as the System Program Office. Contractor support for the study was initiated.

(2) (U) FY 1987 Program: System Specification and Request for Proposal (RFP) package will be prepared for the election of the EC-18 CMMCA contractor. FY 1987 funds will be used for contractor support associated with RFP reparation, source selection, travel and procurement of long lead Government Furnished Equipment (GFE).

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The RFP will be released, proposals eviewed, and source selection will occur. The contract is planned to be awarded as fixed-price. Design of modification by selected contractor will begin. Initial equipment purchases will be made.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: FY 1989 projected activities include design of the modification and long-lead procurement, and fabrication and modification of the first aircraft will begin.

(5) (U) Program to Completion: FY 1990 will be spent completing the modification and installation to the first aircraft. Modification will be initiated on the second aircraft, and flight testing of the first aircraft will begin. Flight testing of the first EC-18 CMMCA will be completed in FY 1991, with Initial Operational Capability (IOC) occuring the second quarter. Modification, installation and test of the second aircraft will be completed by the first quarter of FY 1992, marking system FOC.

C. (U) Major Milestones:

Milestones	Dates
(1) Requirements Study	4th Quarter FY 1987
(2) Contract Source Selection	3rd Quarter FY 1988
(3) Initial Operational Capability (First Aircraft)	2nd Quarter FY 1991
(4) Full Operational Capability (Second Aircraft)	1st Quarter FY 1992

Program Element: 64755F
DOD Mission Area: 451 - Major Ranges and Test Facilities

Title: Improved Capability for DT&E
Budget Activity: 6 - Defense-wide Mission Support

11. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3620, Air Force Flight Test Center (AFFTC)

A. (U) Project Description: The AFFTC, located at Edwards AFB, conducts and supports development test and evaluation and operational test and evaluation of aircraft and aircraft systems, aerospace research vehicles, unmanned miniature vehicles, cruise missiles and parachute delivery/recovery systems. Air Force parachute and cargo handling systems are also evaluated. Recovery support and engineering evaluation is provided to the Space Shuttle program and other transatmospheric vehicles. AFFTC operates two instrumented ranges: the Edwards Flight Test Range and the Utah Test and Training Range (funded in PE 78019F). Additionally, AFFTC operates the USAF Test Pilot School which annually trains fifty DOD, allied and contractor test pilots, flight test navigators and flight test engineers. Improvement/modernization efforts include: Integration Facility for Avionics Systems Testing (IFAST), Integrated Flight Data Processing System (IFDAPS), Advanced Range Data System (ARDS), Modular Airborne Instrumentation System (MAIS), AFFTC Instrumentation Upgrade, Airborne Instrumentation Enhancement, Test Pilot School (TPS) Instrumentation Upgrade, Test Facility for Advanced Aircraft Systems (TFAAS), and Physical Measurement Facility (PMF). IFAST provides a multi-user support facility for full-scale avionics development test and evaluation. IFDAPS is a distributed processing system for Time Space Positioning Information (TSPI) and engineering unit data, based upon mini-computers which can be expanded with modular segments. ARDS is a highly accurate TSPI data and communications system for large areas beyond the present AFFTC range, with significant savings in manpower and range-support costs. ARDS takes advantage of the NAVSTAR Global Positioning System (GPS) and other satellite systems to provide the necessary position data and communications for multiple, simultaneous test vehicles. The MAIS project will develop a high data rate, pulse code modulation, airborne instrumentation system to meet the requirements of future test programs to be conducted at the AFFTC. The AFFTC Instrumentation Upgrade project will upgrade AFFTC range support systems which are becoming saturated. The Airborne Instrumentation Enhancement efforts will upgrade the present outdated, labor intensive calibration and printed circuit board (PCB) laboratory equipment used in support of airborne instrumentation with state-of-the-art equipment. The TPS Instrumentation Upgrade project will upgrade airborne instrumentation systems for TPS aircraft and the associated ground data facilities. Instrumentation and current TPS aircraft are aging and must be upgraded to provide more realistic, reliable, and effective training using current aircraft, equipment and techniques. TFAAS will allow ground testing of the entire aircraft's integrated network software, including all flight control features as well as all avionics. The PMF project will provide for major upgrade or development of physical measurement facilities at the AFFTC such as the weight and balance system, horizontal thrust stands, moment of inertia facilities, gun firing/boresight, remote calibration system, ground vibration/limit of cycle system, antenna pattern system, runway test facilities, and multi-dimentional thrust stand.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: IFAST test program support continued. F-16C/D full simulation capability is continuing, as well as the performance-monitoring and control system. IFDAPS achieved Initial Operational Capability (IOC). ARDS concept development was initiated in conjunction with the ongoing GPS Range Applications program, including requirements definition, Program Management Plan preparation, and a preproduction capability demonstration. AFFTC instrumentation upgrades and equipment purchases continued to keep systems supportable. Generic encryption of existing telemetry systems began and a contract was awarded for a new digital communications switch for the Ridley Mission

Control Center. Upgrade of film recorders was completed, resulting in fewer data reruns and associated lower Operation and Maintenance costs. Data links to other ranges such as Tonopah, NE, were also completed. Airborne Instrumentation Enhancement sensor procurement, calibration lab, and printed circuit board (PCB) lab upgrades continued. Modifications to the Airborne Test Instrumentation System Test Station and development of the MIL-STD-1553 Databus Facility were completed. Test Pilot School (TPS) Instrumentation Upgrade telemetry equipment was installed and a post-flight data analysis system was procured.

(2) (U) FY 1987 Program: Integration Facility for Avionics Systems Testing (IFAST) will complete F-16C/D full simulation and installation of hardware peripherals, adapt data processors to integrated performance, and develop documentation and training procedures. Advanced Range Data System (ARDS): Development of the central computer system, development of the high accuracy system, and planning for procurement and testing of the production articles production which are scheduled for procurement beginning in early FY 1988. Air Force Flight Test Center (AFFTC) Instrumentation Upgrade: Development of an uninterruptible power supply for FTMCC will commence. Mobile telemetry upgrades continue. Cinetheodolite ranging demonstration continues. Airborne Instrumentation Enhancement: Calibration and airborne instrumentation upgrades continue. The Integrated Flight Data Processing System (IFDAPS) interface will be completed fourth quarter TPS Instrumentation Upgrade: Initial Operational Capability (IOC) of the new ground systems will be reached, as well as IOC for the post-flight system. The FY 1987 program also includes funding ($0.9 million) to purchase a commercially available, used medium class twin turboprop aircraft which will be configured and instrumented to support the TPS multi-engine training curriculum. The TPS requirement for an economical multi-engine training aircraft is currently being satisfied by a leased UV-18. The lease for that aircraft expires in February 1987.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: IFAST integration engineering will be performed to properly interface the current IFAST capability with the new three bay addition. ARDS will continue acquisition support from the System's Engineering Technical Assistance (SETA) contractor, acquire a new system to support current high data requirements, buy initial GPS based instrumentation, and continue ongoing support to the Range Applications Joint Program Office. Modular Airborne Instrumentation System (MAIS) The preliminary acquisition strategy calls for competitive development contracts for a new system (demonstration/validation phase) to be awarded in FY 1988. AFFTC Range Instrumentation Upgrade procurement of an uninterruptable power source for the flight test mission control center and continued improvements of the enhanced voice communication switching system. Continued upgrade of the data transmission system between Edwards AFB and the Utah Test and Training Range. Also continued fiber optic installation for local data transmission. Continued upgrades to video systems and mobile telemetry receiving and distribution capabilities. Airborne Instrumentation Enhancement will continue upgrade of airborne instrumentation and laboratory calibration equipment, and upgrades will begin on assigned pacer aircraft to allow more accurate calibration of airspeed. TPS Instrumentation Upgrade will be continue upgrade of the data processing system with IFDAPS equipment and purchase of additional telemetry equipment. Detailed planning for the acquisition and integration of the Test Facility for Advanced Aircraft Systems (TFAAS) will be completed. The Physical Measurement Facility (PMF) project will concentrate efforts on facilities causing O&M problems which can be upgraded relatively easy, and with relatively low dollar amounts. An effort will also be funded with the AFFTC Support Engineering and Technical Assistance (SETA) contractor to define and generate specifications for future upgrades. This funding is required in FY 1988 to alleviate the biggest problem areas and provide a planned, prioritized approach to accomplish future PMF upgrade/developments.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Integrated Flight Data Processing System (IFDAPS): FY 1989 funding will procure more Data Analysis systems, additonal real-time data analysis subsystems and initial spares. This will allow the Integrated Flight Data Processing System (IFDAPS) to support an increased number of simultaneous missions, standardize hardware and software and enable retirement of older systems. Future efforts include integration of the Structures and Flutter Subsystem, integration of the Instrumentation Calibratien Work Station, additional Data Analysis Work stations, and associated initial spares. Advanced Range Data System (ARDS): Completion of development and initial procurement. Future efforts continue procurement. Modular Airborne Instrumentation System (MAIS): Development and fabrication of up to two prototypes from one or more contractors to be flight tested in FY 1990. Implementation of prototype modification (full scale development) and production with associated support will be negotiated as a follow-on contract with a single contractor. Air Force Flight Test Center (AFFTC) Instrumentation Upgrade: FY 1989 and future funding will continue efforts begun in FY 1988. Airborne Instrumentation Enhancement: In FY 1989 and out upgrades of instrumentation will continue. Test Pilot School (TPS) Instrumentation Upgrade: New components and transducers along with the new airborne instrumentation will be installed through FY 1989-FY 1992 to support the TPS. Test Facility for Advanced Aircraft Systems (TFAAS): Planning will continue in FY 1989 with contract award anticipated in FY 1990 for a contract to provide the processing/simulations/display hardware/software. Initial Operational Capability (IOC) for the facility is planned for 1993. Physical Measurement Facility (PMF) funding will continue evaluation and scoping the project. Future efforts will include development and procurement of equipment upgrades.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not Applicable.

12. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: #65101F
DOD Mission Area: #440 - Technical Integration/Studies and Analyses

Title: Project AIR FORCE
Budget Activity: #6 - Defense-Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		17,079	20,300	19,106	20,011	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program funds Project AIR FORCE, the Air Force Studies and Analyses Federally Funded Research and Development Center operated by The Rand Corporation. It provides for continuing analytical research across a broad spectrum of issues and concerns to the Air Force. By design, the Project AIR FORCE research agenda is focused primarily on mid- to long-term concerns. Results and analytical findings obtained from Project AIR FORCE directly impact senior management deliberations on major issues facing the Air Force. Also, written reports of research findings are widely distributed throughout the Air Force and defense community.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	18,245	18,295	18,858	N/A	N/A	N/A

EXPLANATION: (U) The FY 1986 change resulted from Gramm-Rudman reductions; the FY 1987 increase was made by Congress; and the FY 1988 change is due to restructuring the program.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: Project AIR FORCE efforts span functional and organizational boundaries. As a result, the research conducted relates to a wide spectrum of activities in the Air Force. To assure relevance and to prevent unnecessary duplication, each newly proposed research effort is reviewed by the Air Force Assistant Chief of Staff for Studies and Analyses. The results are also deposited with the Defense Technical Information Center for appropriate dissemination to other qualified recipients.

6. (U) WORK PERFORMED BY: All work is performed by The Rand Corporation, Santa Monica, California. The senior Air Staff group established to review, monitor and approve the research effort is chaired by the Deputy Chief of Staff for Research, Development and Acquisition. The Director of Operational Requirements, DCS/Research, Development and Acquisition, as the executive agent, is responsible for the administration of the project.

Program Element: #65101F
DOD Mission Area: #440 - Technical Integration/Studies and Analyses

Title: Project AIR FORCE
Budget Activity: #6 - Defense-Wide Mission Support

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: PE #65101F, Project AIR FORCE

A. (U) Project Description: Project AIR FORCE is a continuing research program. Based on a research plan approved each September, there are approximately 40 research projects in various stages of implementation during the course of each fiscal year. Each research project is initiated, processed and approved in accordance with Air Force Regulation 20-9 which requires General Officer sponsorship and involvement on a continuing basis. The research effort encompasses a broad spectrum of aerospace policy and technical issues and is organized into four research programs: National Security Strategies, Force Employment, Technology Applications and Resource Management.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Research conducted during FY 1986 was keyed to the major issues defined by the Air Force Advisory Group for Project AIR FORCE. Major accomplishments in each research program were:

(U) National Security Strategies: Major research findings were reported on the effects of key arms control parameters on both offensive and defensive strategic weapons; doctrinal preferences, operational practices and equipment capabilities of major allied air forces in Europe; implications of terrorism, particularly state sponsored terrorism; the ability of current and planned USAF/NATO intelligence assets and procedures to support attacks against critical elements of a Soviet/Warsaw Pact air-land offensive; and on possible Soviet responses to Strategic Defense Initiatives in terms of doctrine, strategy, force deployments and arms control behavior.

(U) Force Employment: Efforts spanned both strategic and theater-level tactical forces. Work was completed on defeating and penetrating Soviet air defenses; small Intercontinental Ballistic Missile possible basing and vehicle options; an assessment of strategic force modernization options in light of technical, fiscal and timing constraint uncertainties; a sensitivity analysis of alternative area air defense mixes; development and application of a tactical air apportionment and allocation methodology; and on survival of standoff surveillance platforms.

(U) Technology Applications: The principal focus continued to be on potential space weapon systems and promising technologies. Work was completed on future space launch needs and ways of satisfying these needs; a technological and operational frame of reference for research and development decisions on surveillance mission capabilities; suitable missions and technologies for space based warfighting systems; and the potential impact of technological surprise on operational concepts and organization of an aerospace force.

Program Element: #65101F Title: Project AIR FORCE
DOD Mission Area: #440 - Technical Integration/Studies and Analyses Budget Activity: #6 - Defense-Wide Mission Support

(U) Resource Management: The implementation phase to transfer and install analytical models developed to enhance flexibility and responsiveness of Air Force logistics support is underway. The principal concept is to use the total support system assets to cope with peacetime and wartime uncertainties associated with tactical air forces. In support of Resource and Management 2000, alternative management policies, better methods of quantifying the effects of reliability and maintainability improvements, and suggested improvements in the acquisition process were developed. In close cooperation with the Air Staff, design and implementation of a decision support system for managing the Air Force enlisted personnel force continued. Drawing on findings of over thirty years of Rand research of the acquisition process, a major report covering lessons learned and prescriptions for the future was prepared and presented to Air Force and DOD senior leadership, the Packard Commission and several Congressional committees.

(2) (U) FY 1987 Program: In addition to those efforts continuing from FY 1986, research will focus on deterrence measures and capabilities; enhancing NATO conventional defenses; uses of air power in peripheral conflict; options for countering Soviet relocatable targets; exploiting critical Soviet alliance control mechanisms; electronic combat and defense suppression; air interdiction concepts in support of the land battle; active defense measures against tactical ballistic missiles; survivability of US and Soviet low earth orbit satellites; exploitation of Project Forecast II technology initiatives; examination of air operations survivability; implementation of acquisition policy initiatives; and theater logistics command, control, and communications. Approximately five percent of the research in FY 1987 will be devoted to short-term high priority issues requested by senior Air Force leadership.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The program will build on planned FY 1987 efforts in accordance with guidance and direction by the Air Force Advisory Group for Project AIR FORCE. While specific topics will naturally evolve, Project AIR FORCE will continue to conduct research in those major areas where Rand can make unique contributions to the Air Force. Major areas in which research will likely be conducted include: enhanced conventional defense in the Pacific region including joint Navy-Air Force operations; evolving Soviet strategic and theater warfighting capabilities; continental air defense with emphasis on the cruise missile threat; implications of Strategic Defense Initiative technology and operational concepts for force structure and advanced technology requirements: operational concepts for space; development and acquisition of tactical weaponry using advanced technologies; manpower, personnel, and training tradeoffs associated with future weapon systems; and factors impacting the overall affordability of acquiring, maintaining, and operating future forces.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Project AIR FORCE is a continuing program and the FY 1989 effort will be at essentially the same level of effort as the FY 1988 request. Specific research topics will be individually reviewed and approved by the Air Force Advisory Group with the majority of the effort being directed toward continuing the research initiated in FY 1988.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 65304F
DOD Mission Area: 360 - Support and Base Communications

Title: Acquisition and Command Support Telecommunications
Budget Activity: 6 - Defense-wide Mission Support

1. (U) RDT&E RESOURCES PROJECT LISTING: ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		9,131	10,727	0	0	N/A	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Provides essential communication services to: Aeronautical Systems Division (ASD); Electronic Systems Division (ESD); Space Division (SD); Ballistic Missile Office (BMO); and the Armament Division (AD). This includes switchboards at ESD and SD; Local tielines; equipment rentals; mobile radios for command/disaster control/security police; and official toll calls.

(U) This program transfers to the Operation and Maintenance appropriation in FY 1988.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	6,550	10,763	9,930	N/A	Continuing	N/A

4. (U) OTHER APPROPRIATION FUNDS: Not applicable.

5. (U) EXPLANATION OF CANCELLATION OR DEFERRAL: The Congress and OSD have always strived for commonality among the Services. The AFSC Divisions/Centers currently use RDT&E funds for operation and maintenance type expenses. This change will move those costs to the O&M (3400) appropriation which aligns USAF with the R&D structure of the other services.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

'rogram Element: 65306F
DOD Mission Area: 440 - Technical Integration/Studies and Analyses

Title: Ranch Hand II Epidemiology Study
Budget Activity: 6 - Defense-Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	4,399	7,147	5,777	1,757	76,385	108,673
2767	Ranch Hand II Epidemiology Study	4,399	7,147	5,777	1,757	76,385	108,673

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The United States Air Force, under direction of the White House, is conducting a 20-year epidemiology investigation of Air Force personnel who were involved with aerial dissemination of herbicides in Vietnam from 1962 to 1971 (OPERATION RANCH HAND). The objective of this investigation is to determine whether long-term health effects exist and can be attributed to occupational exposure to phenoxy herbicides and their associated dioxins. This investigation was directed by the Assistant to the President for Domestic Affairs and Policy, through a 16 September 1980 memo to the Secretary of Defense. On 27 March 1981 the Office of Management and Budget confirmed the current administration's desire to continue the study as directed. The importance of this particular study to the dioxin question cannot be overestimated because the Air Force Ranch Hand personnel are the only human population for whom frequency and duration of exposure to the herbicide are known with any accuracy.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	4,699	7,384	4,901	N/A	73,365	105,653

EXPLANATION: (U) Increased estimate in FY 1988 and Additional to Completion is due to White House directed protocol enhancements and more study participants than originally anticipated.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: This is one of several federal studies designed to provide information regarding alleged claims of adverse health effects in Vietnam veterans exposed to Herbicide Orange. The studies include the Air Force study, the Veterans Administration study of twins, and the Centers for Disease Control study of birth defects. These studies are coordinated by an interagency working group, established by the White House.

6. (U) WORK PERFORMED BY: Program controlled and monitored by the Aerospace Medical Division. The United States Air Force School of Aerospace Medicine, Brooks Air Force Base, TX, assists in the monitoring and performs data base management and certain studies and analyses. Science Applications International Corporation, McLean, VA, conducts the

Air Force Health Study Contract which includes physical exams, questionnaires, and statistical analyses.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2767, Ranch Hand II Epidemiology Study

A. (U) Project Description: The purpose of this 20-year study is to determine if long-term health effects exist in Air Force personnel who served in Vietnam and whether such effects might be attributed to occupational exposure to Herbicide Orange. The study involves a comparison of Ranch Hand personnel with Air Force crew members/support personnel serving in Vietnam who were not exposed to herbicides. Comparisons will be made on mortality rates, present and past health status, and future follow-up health status at the 3-, 5-, 10-, 15-, and 20-year periods. Detailed computer searches of Air Force and other Government record systems were used to identify and locate Ranch Hand personnel. A matched control subject was selected for each exposed study subject based on age, Air Force duty specialty, and race. Participation by exposed and comparison study subjects will continue to be on a voluntary basis. Study subjects participated in a comprehensive baseline physical examination in 1982, with emphasis on dermatologic, neuropsychiatric, hepatic, immunologic, reproductive, cardiac, and neoplastic conditions. Questionnaires reconstructing occupational, social, and medical data to quantify morbidity end points and possible confounding factors were administered.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: This year a fertility analysis (birth defects) commenced. The year-3 physical examinations started in FY 1985 were completed in March 1986, and 2,309 study subjects participated. All questionnaires were completed on the participants, their spouses, and study replacements. All questionnaires and physical examinations have been coded, and most have been entered into the data base. A major effort was assimilating the tremendous amount of data gathered into the project data base. This data was analyzed and examined for statistical significance and medical inference. This work will form the basis for the first follow-up morbidity report which will view the changing health status of the Ranch Handers and their offspring and compare those findings with the companion group of study subjects. The annual mortality analysis continued.

(2) (U) FY 1987 Program: The year-5 follow-up phase will be initiated. Medical records and additional series of physical examinations, questionnaires, and laboratory tests will be updated and analyzed. The year-5 physical examinations and questionnaires will commence in the third quarter. The fertility analysis started in FY 1986 will continue. The year-3 morbidity report will be published. The annual mortality analysis will continue.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The balance of the year-5 data (both physical examinations and questionnaires) will be collected during the first half of the year. Data Base compilation will be completed and data analysis will commence. This work will form the basis of the second follow-up morbidity report. The fertility analysis commenced in FY 1986 will be completed by the end of FY 1988. The annual mortality analysis will continue. Cost estimate is based on a negotiated firm fixed price contract awarded in January 1985.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Statistical analyses of the year-5 data will be completed. The year-5 (second follow-up) morbidity report will be published. The fertility analysis report will be published. The annual mortality analysis will continue. Data Base management will continue.

(5) (U) Program to Completion: Ten, 15 and 20-year follow-up morbidity studies are scheduled for 1992, 1997, and 2002; each participant will receive a thorough physical examination and be asked to complete an extensive questionnaire. Mortality analysis will continue every year through 2002. On an annual basis, data will be coded, entered into a data base file, analyzed and examined for statistical significance and medical inference. Findings and conclusions will be published in the USAF School of Aerospace Medicine Aeromedical Reviews and Technical Reports.

C. (U) Major Milestones:

Milestones	Dates
(1) (U) Release of year-3 morbidity report	July 1986
(2) (U) Start second follow-up (year-5) examinations	March 1987
(3) (U) Complete second follow-up examinations	January 1988
(4) (U) Release of year-5 morbidity report	May 1989
(5) (U) Complete longitudinal analysis	September 1992
(6) (U) Start third follow-up (year-10) examinations	March 1992

8. (U) PROJECTS OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 65708F — Title: NAV/RADAR/SLED-TRACK Support
DOD Mission Area: 451 - Major Ranges and Test Facilities — Budget Activity: 6 - Defense-Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	19,506	21,294	24,194	24,959	Continuing	N/A
06TG	6585th Test Group Support	15,506	17,294	20,194	20,959	Continuing	N/A
2900	Radar Target Scatter (RATSCAT) Upgrade	2,000	2,000	2,000	2,000	Continuing	N/A
688G	Aircraft Navigation System Verification	2,000	2,000	2,000	2,000	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The 6585th Test Group at Holloman AFB, NM, and the associated facilities and modernization efforts funded here are part of the Department of Defense (DOD) Major Range and Test Facility Base (MRTFB). The MRTFB is a national asset which is operated and maintained primarily for DOD test and evaluation missions, but is also available to other users having a requirement for its unique capabilities. The unique MRTFB capabilities of the 6585th Test Group include the Central Inertial Guidance Test Facility, the Radar Target Scatter (RATSCAT) facility, and the High Speed Test Track. These facilities are necessary to support a wide range of high priority programs including B-1B, TRIDENT, Peacekeeper, Small Intercontinental Ballistic Missile (ICBM), Advanced Medium Range Air-to-Air Missile (AMRAAM) and various classified programs involving new technology.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	20,671	25,889	26,652	N/A	Continuing	N/A

EXPLANATION: (U) Congressional reduction of funds in FY 1987 defers first year funding for RATSCAT Advanced Measurement System annual real property maintenance requirements and acquisition of a new generic sled for ICBM guidance system testing. FY 1988 reduction to fund higher priority AF programs.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: The 6585th Test Group supports testing for a wide range of high priority customer programs such as B-1B, TRIDENT, Peacekeeper, Small ICBM, AMRAAM and various classified programs involving new technology.

6. (U) WORK PERFORMED BY: The primary contractor, Dynalectron of Washington, D.C., operates and maintains the Radar Target Scatter (RATSCAT) facility.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 2900, Radar Target Scatter (RATSCAT) Upgrade. The RATSCAT main site facility is an outdoor electromagnetic laboratory which measures radar cross-section (RCS) and antenna patterns on weapon systems and subsystems. These measurements are performed using subscale or full scale models, and in some cases actual air vehicles. RATSCAT main site is unique in its ability to characterize signatures and perform measurements on targets of all sizes. However, RATSCAT main site equipment and facilities are predominantly early 1960's vintage and need repair and modernization. The RATSCAT main site is located on the White Sands Missile Range on a dry lake bed made up of the same gypsum salts which form the adjacent White Sands National Monument. These salts are highly corrosive when combined with moisture, and have progressively deteriorated the RATSCAT buildings and equipment. The upgrade project addresses these facility deterioration and equipment issues by: (1) the time-phased replacement of outdated test equipment; (2) the addition of new technology equipment needed for state-of-the-art RCS testing; and (3) programming for future Military Construction Projects (MCP) to construct new permanent facilities designed to withstand the corrosive effects of the local gypsum environment. The RATSCAT upgrade effort for FY 1986 through FY 1988 will procure an automated multiple frequency radar, control and data acquisition system called the Integrated Radar Measurement System (IRMS). The IRMS is a major enhancement in main site test efficiency, expanding capability from manually conducted single frequency RCS measurement to simultaneous, multiple frequency testing controlled by a computer. The FY 1986 RATSCAT main site upgrade MCP includes the development of the Compact Range, a new indoor test facility which will permit small vehicle RCS measurements in a secure environment without test constraints such as wind, weather or satellite overflights. The Compact Range concept enables the RATSCAT main site facility to complement outdoor testing with specific tests wherein the background radar noise is specially controlled and reduced beyond levels achievable outdoors. The instrumentation to complete the Compact Range will be acquired in FY 1989 with an anticipated Initial Operational Capability (IOC) late that year. A continuing RATSCAT main site upgrade program is planned because of the rapidly changing nature of the technology associated with RCS measurements. This program includes the new RATSCAT Advanced Measurement System (RAMS) completed in FY 1985, which will be maintained as the premier RCS facility in DOD.

B. (U) Project: 688G, Aircraft Navigation System Verification. This project conducts standardized tests and evaluations of inertial and inertially-aided aircraft navigation systems for DOD aircraft and weapon delivery systems. Project 688G provides common support for these efforts with a Completely Integrated Reference Instrumentation System (CIRIS) capability. Tasks undertaken by this project include: Inertial Navigation System (INS) Verification Testing, Aided INS Verification Testing, Velocity Sensor Verification Testing, Standard INS Qualification Testing, Form/Fit/Function Testing, management and maintenance of the CIRIS, and minor Improvement and Modernization of the systems as required to support both the project efforts and users with valid support requirements. In FY 1986 and FY 1987 strapdown ring laser gyroscope (RLG) inertial systems will be the primary technology evaluated. In FY 1987 and FY 1988, the verification and development testing of navigation systems will continue with emphasis on radar and stellar-aided inertial navigation systems. Upgrades to the CIRIS will focus on completion of a multiple frequency capability so that the CIRIS can simultaneously support multiple test programs without frequency interference, and acquisition of the Advanced Reference System (ARS) upgrade to the CIRIS. The ARS efforts for FY 1988 will consist of field testing the upgrade which includes incorporation of additional sensors such as Global Positioning System (GPS) and Tactical Air Navigation (TACAN) and miniaturization of the system into a five inch diameter AIM-9 Sidewinder pod for compatibility

with additional aircraft. Additional Advanced Reference System (ARS) systems will be acquired in FY 1989 through FY 1993 to meet projected test requirements. This is a continuing project.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 06TG, 6585th Test Group Support

A. (U) Project Description: The 6585th Test Group is a tenant organization at Holloman AFB, NM, adjacent to the White Sands Missile Range. This project provides institutional funding for operations, maintenance, improvement, modernization, and personnel in the following four major areas. (1) The High Speed Test Track performs rocket sled testing of missile guidance, aircraft ejection systems, and conducts many other types of tests requiring realistic simulations of high acceleration or high velocity environments. The sled-track was used to perform measurements of the Peacekeeper guidance system under environmental stress conditions and has attained a world speed record of over Mach 8 while testing rain erosion degradation of reentry vehicles. The sled track is also vital for developmental testing of guidance subsystems. For the foreseeable future, the track is heavily committed to guidance testing for Peacekeeper and Small Intercontinental Ballistic Missile (ICBM) as well as TRIDENT D-5 guidance system and other non-guidance system testing. (2) The Central Inertial Guidance Test Facility (CIGTF) conducts numerous guidance related test efforts. Typical CIGTF test programs include inertial guidance systems for the Peacekeeper and TRIDENT missile systems, ring laser gyroscope (RLG) development, and gravitational measurements necessary for ballistic missile guidance system testing and development. (3) The Radar Target Scatter (RATSCAT) facilities, including the new RATSCAT Advanced Measurement System (RAMS), are used to measure radar cross-section (RCS) and antenna patterns on selected subscale and full-scale targets. (4) The 6586th Test Squadron provides operational and maintenance support for flight test aircraft staging out of Holloman AFB. Cargo/transport type test bed aircraft are required to support the CIGTF in performing test and evaluation of navigation systems and fighter aircraft are operated and maintained by the 6586th Test Squadron in support of missile development tests conducted on White Sands Missile Range. In addition, the 6585th Test Group performs liason duties for USAF activities on the White Sands Missile Range, and performs full Federal Aviation Administration coordination for all airspace users in the White Sands Missile Range and Holloman AFB flying areas.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Major programs supported by the 6585th Test Group included verification of new "high accuracy" Inertial Navigation Systems (INS) under Project 688G; qualification of new INS systems based on strapdown RLG technology; rocket sled tests of the PEACE MARBLE II and Advanced Concept Ejection Seat (ACES) II aircrew escape systems; rocket sled tests of the Peacekeeper, Small ICBM, and TRIDENT D-5 Guidance Systems; RCS measurement testing for Advanced Drone Test and Drone Design Test programs; flight testing of the Advanced Medium Range Air-to-Air Missile (AMRAAM); the Advanced Dispenser Technology program; High Endo-Defense Interceptor (HEDI) program; continuation of the B-1B avionics effort; testing of the Vertical Shock Isolation System (VSIS) for the Small ICBM basing investigation; Extended Range Interception Technology (ERINT), and Crew Escape Systems Technology (CREST); and various other USAF-directed programs. Maintenance of Real Property and repair/improvements to Real Property and Real Property Installed Equipment was accomplished for the RATSCAT Division.

(2) (U) FY 1987 Program: Major programs which will be supported include Radar Cross-Section (RCS) tests for the Drone Design Test program and numerous USAF-directed efforts; testing of the Peacekeeper, Small Intercontinental Ballistic Missile (ICBM), and TRIDENT guidance systems; rocket sled tests of the Advanced Concept Ejection Seat (ACES) II Escape System, Crew Escape Systems Technology (CREST), Advanced Medium Range Air-to-Air Missile (AMRAAM), High Endo-Defense Interceptor (HEDI), Vertical Shock Isolation System (VSIS), the F-111 Crew Escape System, the Advanced Dispenser Technology program, and the Short Range Attack Missile (SRAM) II. Radar cross-section (RCS) testing for AMRAAM, Small ICBM, and SRAM II is also scheduled, as are the ongoing Inertial Navigation System (INS) verification efforts under Project 688G.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The 6585th Test Group will continue to support many of the prior year programs into FY 1988. These will include rocket sled tests of the SRAM II, ACES II Escape System, AMRAAM, the F-111 Crew Escape System, CREST, and HEDI; RCS tests for AMRAAM, Small ICBM, and numerous USAF-directed efforts; and ongoing INS verification efforts under Project 688G. Other programs scheduled in FY 1988 are guidance tests for the Ground Launched Cruise Missile and a helicopter INS for the Canadian National Defence Headquarters. The improvement and modernization of test equipment for all three test divisions will continue in order to keep pace with technology advances. Real Property and Real Property Installed Equipment (RPIE) repairs and improvements will begin in FY 1988 for the new Radar Target Scatter (RATSCAT) Advanced Measurement System (RAMS) facility. In order to maintain RAMS as a viable, highly accurate RCS measurement facility, additional funding for repairs and improvements are urgently required. Range characterization measurement recently performed at RAMS indicates that the capability to measure low target signatures has begun to degrade due to the desert environment and, if this condition is not corrected, RAMS will no longer be able to make the critical measurements required by Advanced Tactical Fighter (ATF) and other programs with similar requirements. A continuing program of periodic maintenance is required to preclude further deterioration and costly repairs. Due to appropriations below required levels in FY 1987, RAMS RPIE repairs and improvements were deferred. Repairs/improvements to RPIE will be a continuing effort.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Support for the test missions, maintenance and upgrades will continue. Project support from prior year programs will continue and a substantial effort from all divisions in support of the Strategic Defense Initiative is anticipated. Full occupancy and usage of the new RATSCAT facility will occur. A Military Construction Project (MCP) is planned for a new guidance Reliability Test Facility to enable reliability and maintainability testing of inertial navigation, guidance and control systems.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 65806F
DOD Mission Area: 480 - RDT&E Facilities/Management

Title: Acquisition and Command Support
Budget Activity: 6 - Defense-wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		356,429	284,513	0	0	N/A	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Acquisition and Command Support (ACS) provides the resources to support the various staff functions, the technical mission, and support activities at the Air Force Systems Command Acquisition organizations. Categories of cost include civilian pay and the related costs of civilian personnel, travel, transportation, contractual services, supplies, and equipment.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	356,520	285,063	308,865	N/A	Continuing	N/A

(U) This program transfers to the Operation & Maintenance appropriation, PE 72806F in FY 1988.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) EXPLANATION OF CANCELLATION OR DEFERRAL: The Congress and OSD have always strived for commonality among the Services. The AFSC Divisions/Centers currently use RDT&E funds for operation and maintenance type expenses. This change will move those costs to the O&M (3400) appropriation which aligns USAF with the R&D structure of other services.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 65807F
DOD Mission Area: 451 - Major Ranges and Test Facilities

Title: Test and Evaluation Support
Budget Activity: 6 - Defense-Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	403,841	291,729	304,839	316,669	Continuing	N/A
06RB	Arnold Engineering & Development Center (AEDC)	155,888	143,334	147,285	152,377	Continuing	N/A
06ZA	Armament Division (AD)	106,500	44,135	45,075	47,008	Continuing	N/A
06YA	Air Force Flight Test Center (AFFTC)	100,153	59,535	66,452	70,172	Continuing	N/A
06UC	4950th Test Wing (4950 TW)	41,300	44,725	46,027	47,112	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Test and Evaluation Support program provides resources to operate the above Air Force test activities which are included in the Department of Defense (DOD) Major Range and Test Facility Base (MRTFB). The MRTFB is a national asset which is operated and maintained primarily for DOD test and evaluation missions, but is also available to other users having requirements for its unique capabilities. Test facilities funded within this program include wind tunnels, rocket test cells, space chambers, armament ranges, climatic test facilities, avionics test facilities, dry lakebed landing sites, and instrumented ranges. Test and evaluation support is also provided to other government agencies, commercial industry, and foreign customers. Major DOD programs supported include Peacekeeper, TRIDENT, Pershing, Advanced Medium Range Air-to-Air Missile, B-1B, F-15 and F-16.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	426,686	304,151	312,042	N/A	Continuing	N/A

EXPLANATION: (U) The current FY 86 funding level reflects reductions made by the Gramm-Rudman-Hollings Act. The current FY 87 funding level reflects Congressional reductions and current OSD fiscal guidance. The FY 88 funding level represents Air Force adjustments to fund higher priority programs.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: The test organizations provide test and evaluation support to Air Force programs and those of other Services and government agencies. Examples include the Air Launched Cruise Missile, F-15, F-16, Peacekeeper, Inertial Upper Stage and Space Transportation System. Additional related activities are covered under each project. Depot Maintenance Industrial Funds to support Air Force Systems Command test and evaluation aircraft is contained in P 65863F, RDT&E Aircraft Support. Techinical capability improvement and modernizaton tasks are funded in PE 64755F, Improved Capability for DT&E. Beginning in FY 1987 base operating support funding for Arnold Air Force Station (AFS), TN, Eglin AFB, FL, and Edwards AFB, CA, was transferred to PE 65894F, Real Property Maintenance RDT&E, and PE 65896F, Base Operations (RDT&E), in compliance with the FY 1985 Appropriations Conference Report.

6. (U) WORK PERFORMED BY: Primary contractors performing test support at each center, shown in parentheses, include: SVERDRUP Technologies, Inc., Schneider Services, Inc. and Calspan Field Services, Inc. (AEDC); RCA Service (AD); and Computer Science Corporation (CSC) (AFFTC).

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 06RB, Arnold Engineering and Development Center (AEDC)

A. (U) Project Description: AEDC, located at Arnold AFS, TN, provides ground environmental test support for Air Force aeronautical, missile and space programs as well as other DOD agencies, government agencies and industry programs. Major programs supported include Minuteman, Peacekeeper, F-15, B-1B, Air Launched Cruise Missile, Antisatellite Missile, Short Range Attack Missile II and Advanced Ballistic Reentry Systems. The center has three test facilities comprised of wind tunnels, altitude rocket cells, arc heaters, aeroballistic ranges, space chambers plus administrative and technical support facilities. The test facilities are: (1) Von Karman Gas Dynamic Facility which performs aerodynamic testing of scale model aircraft, missile and space systems from Mach 1.5 to 10.0, testing of large and full-scale satellites, sensors and space vehicles in a simulated space environment and tests of projectiles (both high performance and conventional guns) at various altitudes and reentry conditions; (2) Engine Test Facility which provides altitude environmental testing for aircraft, missile and spacecraft propulsion systems including turbojets, turbofans, and both liquid and solid propellant rockets; and (3) Propulsion Wind Tunnel Facility which provides testing of large-scale models, and in some cases, full scale engine inlet combinations, missiles and space boosters together with their propulsion systems at Mach numbers from 0.5 to 4.5. The center also supports programs of the National Aeronautics and Space Administration (NASA), such as Space Transportation System, the Army Ballistic Missile Division and the Navy, as well as technology support to the Department of Energy. The Center's facilities are national assets that provide unique test capabilities not available elsewhere.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Arnold Engineering and Development Center (AEDC) provided vital aerospace

1049

ground/environmental test support to many of the nation's highest priority aerospace systems development programs such as Peacekeeper, Small Intercontinental Ballistic Missile (SICBM), Minuteman, Advanced Ballistic Reentry System (ABRES), Navstar, PAM-D, Star 48, Miniature Systems, Advanced Tactical Fighter (ATF), F-15, F-16, Trident II, Aircraft Propulsion Subsystem Integration, Joint Cruise Missile, Strategic Defense Initiative (SDI), and Short Takeoff, Landing and Maneuver (STOLM) Fighter Technology. Turbine engine programs included the F109, F100 Engine Model Derivative Program/Component Improvement Program (CIP), F101 CIP, F110 CIP, and Joint Advanced Fighter Engine. Other aerospace propulsion, flight dynamics materials testing, and munitions development testing was provided to NASA, Air Force, Army, Navy, and the Japanese XF-3 engine. The Aeropropulsion Systems Test Facility (ASTF) achieved initial operational capability (IOC) on 1 Oct 85. Customer testing began in Jul 86. The Captive Trajectory Support (CTS) system (design, fabrication and installation) in Tunnel 16S was completed. Restoration of the J-5 Rocket Motor Test Cell was begun after the cell was destroyed during a Peacekeeper Stage II motor test on 23 Nov 85.

(2) (U) FY 1987 Program: Major test efforts are planned to support Peacekeeper, SICBM, Interal Upper Stage (IUS), ABRES, SSTS, Intelsat VI, Navstar, NASP, STOLM Fighter Technology, F-16, B-1B, Minuteman, Joint Cruise Missile, SDI, and the ATF. Turbine engines and flight dynamics testing in the 16 feet and 4 feet wind tunnels will continue to dominate workload. Test programs are scheduled for the F109, F100 Increased Performance/CIP, F101 CIP, F110 CIP/Increased Performance, Joint Advanced Fighter Engine, and the Israeli Lavi fighter. Continued support will be provided to flight dynamics, aerospace propulsion, munitions development, Army, Navy, Air Force Logistics Command, NASA, and industry. The ASTF facility will begin testing of the Joint Technology Demonstrator Engine and begin preparation for the Advanced Tactical Fighter. Restoration of the J-5 Rocket Test Cell will be completed, and the test cell will again be used to support major rocket motor development tests. Efforts to improve test methodology and improve existing facilities will continue. Costs will increase in FY 1987 because of inflation and increased requirements for contractor support of ASTF, along with the new contractor personnel benefits, and higher utility costs. Beginning in FY 1987, base operating support funding for Arnold Air Force Station, TN, was transferred to PE 65894F, Real Property Maintenance RDT&E and PE 65896F, Base Operations (RDT&E) in compliance with the FY 1985 Appropriations Conference Report. Design of the Large Rocket Test Facility will continue with 35% design completion in June 1987.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: AEDC will continue to contribute to the successful development of DOD weapon systems and technologies such as Peacekeeper, Small Intercontinental Ballistic Missile (SICBM), Advanced Ballistic Reentry System (ABRES), Advanced Tactical Fighter (ATF), SSTS, classified surveillance programs, Short Take Off Landing and Maneuver Demonstration (STOLM), Minuteman, Strategic Defense Initiative (SDI), National Aerospace Plane (NASP), High Endoatmospheric Interceptor (HEDI). Heavy emphasis on turbine engines will continue for the F109, F100 Increased Performance, F110 Increased Performance/Component Improvement Program, F101 CIP, and the Joint Advanced Fighter Engine. Continued support will be provided to flight dynamics, aerospace propulsion, ordnance technology, conventional munitions, space systems testing, the Army, Air Force, Navy, NASA, and industry programs. The construction design effort for the Large Rocket Test Facility (LRTF) will continue to meet the projected FY 1989 construction start date with site preparation beginning in FY 1988.

Program Element: 65807F — Title: Test and Evaluation Support
DOD Mission Area: 451 - Major Ranges and Test Facilities — Budget Activity: 6 - Defense-Wide Mission Support

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: AEDC will continue testing many of the major DOD weapon systems such as Peacekeeper, Small Intercontinental Ballistic Missile (SICBM), Advanced Ballistic Reentry System (ABRES), Advanced Tactical Fighter (ATF), Minuteman, STOLM Demonstrator, National Aerospace Plane and numerous classified projects. Heavy emphasis on turbine engine testing will continue for the NASP, Advanced Tactical Fighter Engine (ATFE), F101 CIP, F100 Improved Performance Engine (IPE), F110 IPE, and development work for the Expendable Turbine Engine program. Significant support will be required for aircraft/stores integrations, reentry vehicle heat shield materials development, bore sight error measurements for infrared and radar guided missile/entry systems, spacecraft thermal-vacuum qualification ramjet powered missiles and the ehtire range of systems being developed under the Strategic Defense Initiative umbrella. Increased space chamber workload is projected for the Boost Surveillance and Tracking System (BSTS), Space Surveillance and Tracking System (SSTS) and the Neutral Beam Particle System (NBPS). In addition, AEDC will provide a broad test spectrum of support to flight dynamics, aerospace propulsion, advanced technology, and conventional munitions programs for the Army, Navy, Air Force, NASA and private industry. Construction for AEDC's Large Rocket Test Facility (LRTF) will begin in FY 1989.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not Applicable.

9. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 06ZA, Armament Division (AD)

A. (U) Project Description: AD is located at Eglin AFB, FL, and is responsible for Air Force nonnuclear armament development. Eglin AFB, located in northwest Florida, is the largest air force base, encompassing 724 square miles of land test area and 86,500 square miles of water test ranges extending almost 240 miles south into the Gulf of Mexico. AD accomplishes technology research, engineering development, test, evaluation, and initial acquisition of USAF nonnuclear munitions. AD, as the USAF focal point for munitions integration into aeronautical systems; conducts and supports USAF weapons effectiveness testing, electronic combat testing, electronics surveillance and control testing, and aeronautical systems testing. Examples of test programs include: Advanced Medium Range Air-to-Air Missile (AMRAAM), the Airborne Self Protection Jammer (ASPJ), the French Durandal runway cratering munition; and environmental testing of entire aircraft in the McKinley Climatic Laboratory. To accomplish its mission, AD utilizes over 50 instrumented test areas, sites, and ranges, and operates 41 aircraft of seven different types. The range resources are divided into four general categories: Armament Systems Test Environment, Electromagnetic Test Environment, Multipurpose Instrumentation, and the Water Test Areas. The aircraft used are F-4s, F-15s, F-16s, F-111s, A-10s, T-38s, and UH-1Ns. The test and evaluation effort is funded under this program element. Other AD personnel are funded under PE 65806F, Acquisition and Command Support. Beginning in FY 1987, base operating support funding for Eglin AFB, FL, was transferred to PE 65894F, Real Property Maintenance (RDT&E), and PE 65896F, Base Operations (RDT&E), in compliance with the FY 1985 Appropriations Conference Report.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: AD funding was used to: operate, maintain, and upgrade the highly instrumented Gulf Test Range complex at Eglin AFB; conduct and support testing in the areas of nonnuclear munitions, electronic combat, missiles and munitions/aeronautical system integration; support USAF, OSD, and other government agencies in test programs; and to provide administrative, logistical and technical support to approximately 10,000 assigned tenant personnel. Major programs supported were: Advance Medium Range Air-to-Air Missile (AMRAAM), Precision Location Strike System (PLSS), F-15/F-16 Seek Eagle, I-2000 Hardened Target Weapon, Chicken Little, IR Maverick, AGM-130, Gulf Range Drone Control Upgrade System, ASPJ, and the Joint Tactical Information Distribution System (JTIDS).

(2) (U) FY 1987 Program: Armament Division (AD) funding will continue to support critical test and evaluation efforts for developing nonnuclear munitions and electronic combat systems. AMRAAM, AGM-130, I-2000, F-15/F-16 Seek Eagle, ASPJ, and PLSS testing will continue in FY 1987. Additional test programs scheduled in FY 1987 include the F-16 Multi-role fighter, the AIM-9P-4/AIM-9L Seeker Certification and Comparison, the Infrared Search and Track System, the Aircrew Eye and Respiratory Protection flight demonstration, and the AN/ALR-56C Radar Warning Receiver. Beginning in FY 1987, base operating support funding for Eglin AFB, FL, was transferred to PE 65894F, Real Property Maintenance (RDT&E), and PE 65896F, Base Operations (RDT&E), in compliance with the FY 1985 Appropriations Conference Report.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: AD projects supporting over 600 programs in FY 1988. Funds requested for FY 1988 represent the minimum necessary for adequate support of firm development test and evaluation commitments for conventional munitions and electronic combat systems needed by the using commands. In addition to continuing F-15 and F-16 munitions certification projects (Seek Eagle), AMRAAM, AN/ALR-56C, AIM-9P-4, and F-16 Multi-role fighter tests FY 1988, AD will begin testing the Hypervelocity Missile Demonstration and the Inertial Guidance Technology Demonstration.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 Request: Funds requested for AD in FY 1989 are the minimum necessary to support adequate developmental test and evaluation of non-nuclear munitions and electronic combat systems. Seek Eagle store certification testing on F-15 and F-16 aircraft will continue to support the tactical forces, as will testing of AMRAAM and the AGM-130. Additional test programs which will be supported in FY 1989 will include the AN/ALQ-161A FOT&E, Low-Cost Seekers, ALR-74 Update, ASPJ Updates, and the Joint Surveillance Target Attack Radar Systems.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not Applicable.

10. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

Program Element: 65807F
DOD Mission Area: 451 - Major Ranges and Test Facilities

Title: Test and Evaluation Support
Budget Activity: 6 - Defense-Wide Mission Support

(U) Project: 06YA, Air Force Flight Test Center (AFFTC)

A. (U) Project Description: The AFFTC, located at Edwards AFB, conducts and supports development and operational test and evaluation of aircraft and aircraft systems, aerospace research vehicles, unmanned miniature vehicles, cruise missiles and parachute delivery/recovery systems. Air Force parachute and cargo handling systems are also evaluated. Recovery support and engineering evaluation is provided to the Space Shuttle program and other transatmospheric vehicles. AFFTC operates two instrumented ranges: the Edwards Flight Test Range and the Utah Test and Training Range (funded in PE 78019F by the O&M appropriation). Additionally, AFFTC operates the USAF Test Pilot School which annually trains fifty DOD, allied and contractor test pilots, flight test navigators and flight test engineers.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishment: Major weapon systems undergoing testing at Edwards included the B-1B, F-16 and F-15 Multi-Stage Improvement Programs, the Antisatellite system, Low Altitude Navigation and Targeting Infrared System for Night (LANTIRN), HH-60, B-52 Strategic Systems upgrades, Common Strategic Rotary Launcher, cruise missile evaluations, and technology development efforts such as the X-29 and F-15 Digital Electronic Flight Control System. Additional programs under test included the F-16 Advanced Fighter Technology Integration Program, F-111 Avionics Modernization Program, F-20, and the C-17 parachute and load extraction system development effort. Continuing support was provided for follow-on operational testing of cruise missiles (ALCM and GLCM) and various classified programs.

(2) (U) FY 1987 Program: AFFTC has firm customer forecasts for the year which show continuation of the surge in testing begun in FY 1984. The B-1B, B-52 strategic programs, cruise missile, F-16, F-15, LANTIRN, C-17 parachute and load extraction system, X-29, Antisatellite, and F-20 flight test programs will all continue with an increased pace of activity. F-15E testing will start. Beginning in FY 1987, base operating support funding for Edwards AFB, CA, was transferred to PE 65894F, Real Property Maintenance (RDT&E), and PE 65896F, Base Operations RDT&E, in compliance with the FY 1985 Appropriations Conference Report.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The AFFTC customers workload forecast continues to grow into FY 1988. The B-1B, B-52 strategic programs, cruise missiles, F-16, F-15, F-15E, LANTIRN, C-17 parachute and load extraction system, X-29, and Antisatellite will continue testing. The Short Take-Off and Landing and Maneuvering Technology F-15, Combat Talon II, and Navstar Global Positioning System Integration on various aircraft will start in FY 1988. In the aggregate, these test program requirements represent a substantial increase in AFFTC support activity. Space Shuttle missons will restart and continue to require support from Edwards AFB during the initial start-up period. The Combat Talon II test should be completed by the end of FY 1988.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The AFFTC customer workload forecast is projecte[illegible] peak in FY 1989. With additional Space Shuttle landings requiring Edwards support, flight time will come at a pr[illegible] Programs requiring support will include B-1B, B-52 Strategic systems, cruise missiles, short range attack

missile, F-16, F-15, F-15E, C-17 parachute and load extraction system, X-29, Antisatellite system, the F-15 short take-off and landing and maneuvering technology aircraft, and NAVSTAR Global Positioning Syatem Testing on both aircraft and range systems. Short Range Attack Missile II testing will start. In the aggregate, these test programs requirements represent a substantial increase in AFFTC support activity.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not Applicable.

11. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 06UC, 4950th Test Wing (4950 TW)

A. (U) Project Description: The 4950th Test Wing, Aeronautical Systems Division, Wright-Patterson AFB, OH, performs flight tests of aircraft and airborne systems, supports space vehicle tracking for the Air Force Systems Command's (AFSC) Space Division, other DOD agencies, and the National Aeronautics and Space Administration. The Wing operates AFSC's major flight test aircraft modification facility. Flight tests vary from evaluations of an airborne side-firing cannon to investigation of state-of-the-art airborne laser systems and night attack sensors. The Wing has the capability to conduct full-scale engineering evaluations, airborne instrumentation and data reduction, flight test aircraft modification and technical photo documentation. Staging out of 13 overseas bases, the Advanced Range Instrumentation Aircraft (ARIA) fleet of seven aircraft provide telemetry support for the National Aeronautics and Space Administration and DOD missile launches out of Cape Canaveral, FL, and Vandenberg AFB, CA. Fabrication support is also provided to the Air Force Wright Aeronautical Laboratories.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: ARIA provided telemetry support to DOD and NASA missile and space vehicles including TRIDENT, Peacekeeper, Inertial Upper Stage, Pershing, TITAN, Poseidon, Space Shuttle, National Oceanic and Atmospheric Administration, air to air missiles, and Cruise Missile. Work continued on the Wing's Computer Aided Manufacturing (CAM) modernization program. Wing crews continued gathering baseline performance test data on the C-18 aircraft. Increased C-18A training flights exercised the logistics supportability of the aircraft systems and the first EC-18B ARIA operational telemetry support missions have been highly successful. Extensive aircraft modification continued on the EC-18B/ARIA conversion project, with two aircraft in the modification process. The Sonobouy Missile Impact Location System (SMILS) will be installed in a prototype configuration on a C-18A and flight tested before this aircraft enters the ARIA conversion effort. The SMILS mission will be an additional task performed by the ARIA fleet which complements the traditional telemetry relay and recording functions.

(2) (U) FY 1987 Program: Continue ARIA and other flight test support for DOD and NASA programs. Continue

support for specified DOD flight test programs such as Mark XV Identification Friend or Foe, C-5 Space Cargo Modification, and Advanced Avionics Study. The in-house integrated Computer Aided Design/Computer Aided Manufacturing (CAD/CAM) system will be used to conduct engineering design fabrication for flight test aircraft modifications. The second EC-18B/ARIA will be flight tested and enter operational service. Another EC-18B/ARIA conversion will be in process.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: To continue flight test and ARIA support of DOD and NASA programs and continue support for Joint Surveillance and Target Attack Radar System. An additional EC-18B ARIA conversion will be completed during FY 1988 and the aircraft will enter the ARIA operational fleet. The in-house integrated CAD/CAM system will be used to conduct engineering design and fabrication for flight test aircraft modifications.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Program: Continue ARIA and other flight test support for DOD & NASA programs. Continue support in both fabrication/modification and flight test to the Air Force Wright Aeronautical Laboratories and other DOD and government organizations. The final EC-18B ARIA will enter operational service. The ARIA fleet will support a large backlog of space vehicle launches as the Space Shuttle and newly built expendable launch vehicle flight operations ramp up from a modest level in 1988. CAD/CAM capabilities will be improved with the most recent generation of CAD equipment replacing older, obsolete CAD equipment in an orderly manner that will result in increased engineering design throughput.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not Applicable.

12. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 65808F
DOD Mission Area: 440 - Technical Integration/Studies & Analyses

Title: Development Planning
Budget Activity: 6 - Defense-Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		15,938	22,710	25,376	27,445	Continuing	N/A
3360	Technical Support	2,000	3,144	6,212	8,339	Continuing	N/A
3361	Mission and System Planning	13,938	19,566	19,164	19,106	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program (previously titled Advanced Systems Engineering/Planning) was redefined to fund two aspects of development planning. The first, now budgeted in project 3360, is the technical support to development planning previously budgeted in this program. The second, now budgeted in project 3361, is funding for development planning which was previously provided via the process of "assessment." Specifically, project 3361 provides dedicated funds for development planning for new classes of systems, capabilities, and mission area planning. The Air Force has the inherent responsibility to conduct development planning to convert operational requirements into effective weapons systems. This program focuses technology to meet these requirements by performing concept formulation studies, mission analyses, and initial acquisition planning. The program will be used to focus implementation of PROJECT FORECAST II initiatives. The major Air Force operating commands work directly with Air Force Systems Command to identify critical requirements areas to prioritize the use of these funds.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	17,000	23,144	26,212	N/A	Continuing	N/A

EXPLANATION: (U) Differences reflect Gramm-Rudman reductions and inflation adjustments.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: Technical support and system and mission planning performed in this program are uniquely related to the overall Air Force RDT&E budget. These types of development planning are used to integrate emerging technologies in the Air Force Science and Technology (S&T) base into candidate system options for acquisition development. As such, development planning is related to the Air Force S&T base as well as the subsequent advanced/engineering development programs which stem from concept feasibility studies and mission area analyses funded in this program.

Program Element: 65808F Title: Development Planning
DOD Mission Area: 440 - Technical Integration/Studies & Analyses Budget Activity: 6 - Defense-Wide Mission Support

6. (U) WORK PERFORMED BY: Technical Support (Project 3360) is primarily provided by the Aerospace Corporation, El Segundo, CA, and the MITRE Corporation, Bedford, MA. Mission and System Planning (Project 3361) is performed by numerous system contractors and analytical service companies. The largest current contracts are with E-Systems, St. Petersburg, FL; General Research Corporation, Santa Barbara, CA; North Dakota State University, Fargo, ND; Scientific Application International Corporation, Dayton, OH; and Sperry Corporation, Great Neck, NY.

7. (U) PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3360, Technical Support. This project provides technical support for the development planning function. The effort includes scientific and technical support for aeronautical, space, armament, aeromedical, ballistic missile, and command, control, communications, and intelligence (C^3I) development planning activities. In FY 1986, specific technical support was provided for the Tactical Air Control System, mission analysis for assured space operations, and space support for the relocatable target problem. In FY 1987/88/89 this project will continue to provide technical support for tactical C^3I planning and space systems architecture, and will add technical support for specific strategic, airlift, and armament system planning.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3361, Mission and System Planning.

A. (U) Project Description: This project performs development planning for new classes of systems, capabilities, and mission area planning to convert operational requirements into effective weapon systems. It performs conceptual studies, mission analyses, and initial system acquisition planning to focus technology into those weapon systems. The project will also focus on implementing the initiatives of PROJECT FORECAST II, the Air Force's comprehensive study to identify new technologies with exceptional promise for improving future war fighting capabilities.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Air Force Systems Command conducted planning projects relating to strategic relocatable targets, advanced tactical battle management, advanced transport technology, military airlift command airlift survivability, boost glide vehicles, high power microwave systems, assured space operations, cruise missile defense, fiber optics employment, space based radar, and advanced strategic aerospace crew systems.

(2) (U) FY 1987 Program: This program will continue planning projects for night in-weather survivable attack; boost glide vehicles; future propulsion systems; atmospheric surveillance technology; future aircraft electrical systems; future fuels; strategic relocatable targets; space based radar; lethal command, control, and communication (C^3) countermeasure target definition and utility; and advanced tactical battle management concepts. The program will complete planning projects for advanced transport technology, follow-on weasel, military airlift survivability, fiber optics employment, cruise missile defense, and high power microwave systems. The planning projects for advanced high

altitude crew protection systems, reconnaissance-attack-fighter training systems, and tanker survivability will be initiated. It will also initiate projects implementing PROJECT FORECAST II.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The FY 1988 program will continue implementing PROJECT FORECAST II and the following planning projects. Advanced Tactical Battle Management: concepts will be developed for 21st Century tactical air control systems in support of the battlefield commander. Night In-Weather Survivable Attack: investment strategies will be determined to provide a night in-weather survivable attack capability against surface targets in the 21st Century. Advanced Propulsion System: concepts will be examined for potential propulsion systems for an advanced turbine engine in the 5-12 thousand pound thrust size in support of small tactical/trainer aircraft for the 2000 time period. Planning efforts will also be continued in support of space-based radar concepts, atmospheric surveillance technology, and long-range command, control, and communications concepts. The program will complete planning projects relating to tanker survivability, future aircraft electrical systems, future fuels, survivable high frequency (HF) communications, crew integration concepts for high acceleration cockpits, boost glide vehicles, and advanced high altitude crew protection systems. This is a planning program and cost estimates are based on engineering judgement and comparison with similar planning efforts.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The FY 1989 program will continue implementing PROJECT FORECAST II initiatives and transitioning operational requirements into effective aeronautical, space, armament, aeromedical, ballistic missile, and command, control, communication and intelligence systems. The planning projects relating to atmospheric surveillance technology, space based radar, advanced tactical battle management, and identification-friend-foe-neutral will continue. The program will complete planning projects relating to night in-weather survivable attack and future propulsion systems. This is a planning program and cost estimates are based on engineering judgement and comparison with similar planning efforts.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 65809F
DOD Mission Area: 451 - Major Range & Test Facilities

Title: Dynamic Coherent Measurement System (DYCOMS)
Budget Activity: 6 - Defense-wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		0	0	12,340	9,224	7,241	28,805

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This new start effort supports the increasing interest in applying Low Observable technology to Aircraft and Missiles i.e. Advanced Technology Bomber, Advanced Cruise Missile, Advanced Tactical Fighter and Advanced Tactical Aircraft. With their associated low radar cross section there exists the requirement to adequately measure free flight dynamic characteristics. The requirement for such a capability rests with the concern that static measurements at either outdoor or indoor radar ranges do not permit the acquisition of realistic signatures as will be encountered in operational scenarios planned. The effort consists of two years to solicit, build and confirm the radar and range performance characteristics and outyear operation and maintenance.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: Not Applicable.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: At this time, there are no other Government nor industry related activities involved with project execution.

6. (U) WORK PERFORMED BY: Contract will be awarded by Air Force Systems Command, Andrews AFB, MD.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 65809F, Dynamic Coherent Measurement System

A. (U) Project Description: Upon completion of the facilities, government and industry designs shall be examined to confirm realistic dynamic free flight radar cross section necessary to confirm specifications. The subsequent evaluation of radar cross section measurements will permit the Government to quantify contractor candidate designs and/or modification to Government owned platform. Without this facility, the Government will not be postured to select among industry designs whose theoretical and laboratory predictions reportedly achieve very low radar cross section.

Program Element: 65809F
DOD Mission Area: 451 - Major Ranges & Test Facilities

Title: Dynamic Coherent Measurement System (DYCOMS)
Budget Activity: 6 - Defense-wide Mission Support

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Not Applicable.

(2) (U) FY 1987 Program: Not Applicable.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The planned FY 1988 effort for DYCOMS will be contractor selection, procurement of equipment, and late in the year, the beginning of assembly of the radar range. FY 1988 funds are primarily for equipment for the range and are required to support facility operational readiness by FY 1989. Program cost estimate is category III, budgetary. Program costs are based on past experience and current equipment costs. The costs reflect contractor cost proposals as of February 1986 escalated to then year dollars using current inflation rates.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The planned FY 1989 effort for DYCOMS will be completion of equipment assembly and start of system checkout to facilitate FY 90 utilization by the services and their contractors.

(5) (U) Program to Completion: Efforts remaining beyond FY 89 are for routine operation and maintenance.

C. (U) Major Milestones:

Milestones	Dates
(1) (U) Contract Award	October 1987
(2) (U) Preliminary Configuration Review	December 1987
(3) (U) Final Configuration Review	March 1988
(4) (U) Assembly Start	September 1988
(5) (U) Assembly Completion	July 1989
(6) (U) System Checkout Complete	December 1989

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 65863F
DOD Mission Area: 454 - Other Test and Evaluation Support

Title: RDT&E Aircraft Support
Budget Activity: 6 - Defense-Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	TOTAL FOR PROGRAM ELEMENT	52,105	60,000	59,034	60,862	Continuing	N/A
2111	Armament Division	9,137	9,999	10,064	11,852	Continuing	N/A
2112	Air Force Flight Test Center	26,384	32,503	29,006	28,045	Continuing	N/A
2114	4950th Test Wing	16,784	17,498	19,964	20,965	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The RDT&E aircraft support program provides resources for maintaining all Air Force Systems Command assigned test and test support coded aircraft which are included as a portion of the Department of Defense Major Range and Test Facility Base. Funds are used to pay for depot level type maintenance such as: Programmed Depot Maintenance (PDM), which is the calendar-based cyclic scheduling of aircraft into the depots for update/inspection; modifications and Time Compliance Technical Orders (TCTO); engine overhauls; exchangeables (recoverable components, such as fuel pumps and electric motors, returned to the depots for repairs); depot provided area assistance; and assorted equipment support that requires DMIF reimbursement. This program currently supports 189 RDT&E aircraft of 24 different types. Many of these aircraft are unique (pre-production, one-of-a-kind, etc.), and the majority are highly modified and uniquely instrumented. The wide variety and small quantity of each type aircraft possessed, the unique/highly modified condition of the test aircraft, the often dedicated status, and the individual work packages (when compounded by the demanding nature of the test environment) result in many challenging management problems which are routinely solved to assure that this large fleet of test aircraft is properly maintained. This program element began in FY 1985.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	55,547	62,404	60,961	N/A	Continuing	N/A

EXPLANATION: (U) Current funding represents FY 1987 Appropriations Act, Department of Defense Fiscal Guidance and changes in the programmed depot maintenance schedules.

Program Element: 65863F
DOD Mission Area: 454 - Other Test and Evaluation Support

Title: RDT&E Aircraft Support
Budget Activity: 6 - Defense-Wide Mission Support

. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

. (U) RELATED ACTIVITIES: The aircraft supported by this program element are either the primary test vehicle or provide test support for Air Force Systems Command (AFSC) research, development, test and evaluation projects. Prior to FY 1985, funding for this Test and Evaluation aircraft support requirement resided in over 60 RDT&E support and weapon systems test programs. In FY 1985, all funding was consolidated within PE 65863F to enhance management visibility and program stability, and to make the program consistent with similar Air Force, as well as Army and Navy, aircraft support programs.

. (U) WORK PERFORMED BY: Depot level maintenance is performed either organically (by the Air Force Logistics Command (AFLC) Air Logistics Centers (ALCs)) or contractually (with the ALCs negotiating/administering the contract). Organically, work is performed at all five AFLC ALCs: Ogden ALC, Hill AFB, UT; Oklahoma City ALC, Tinker AFB, OK; San Antonio ALC, Kelly AFB, TX; Sacramento ALC, McClellan AFB, CA; and Warner Robins ALC, Robins AFB, GA. Contractually, work is being performed by McDonnell Douglas Corp., Tulsa, OK; Boeing Military Airplane Company, Wichita, KS; Lockheed Corp., Marietta, GA; Hayes International Corp., Birmingham, AL; and Vought Corp., Dallas, TX. Other contractors may be used, but this is dependent upon the projected workloads within each AFLC ALC.

7. (U) PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2111, Armament Division (AD)

A. (U) Project Description: The Armament Division (AD), Eglin AFB, FL, is the prime United States Air Force organization responsible for nonnuclear munitions armament development. AD accomplishes technology research, engineering development, test and evaluation and initial acquisition of USAF nonnuclear munitions, is the USAF focal point for munitions integration in aeronautical systems, conducts and supports USAF weapons effectiveness testing, electromagnetic warfare testing, electronic surveillance and control testing, and aeronautical systems testing. AD currently has the following types and quantities of test/test support aircraft assigned: A-10A(3); F-4D(5); F-4E(2); F-15A(4); F-15B(2); F-15C(1); F-15D(1); F-16A(8); F-16B(1); F-16C(1); F-111E(2); UH-1N(2); and T-38A(6). Total aircraft assigned: 38.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: In FY 1986, Programmed Depot Maintenance (PDM) was accomplished on two F-4s. Two F-15s were input to the speedline for Time Compliance Technical Order (TCTO) update and painting. Ten F-16s were input to the FALCON Structure program. One F-16A received the Falcon Rally II update. TCTOs were accomplished on two F-111s. One UH-1N had an on-condition maintenance inspection accomplished. One UH-1N had a condition inspection

accomplished. Two T-38s received engine and flight control modifications. AD flew 5,702.4 hours which generate corresponding engine overhaul and exchangeable requirements.

(2) (U) FY 1987 Program: Programmed Depot Maintenance (PDM) will be accomplished on one F-4; Speedline and Time Compliance Technical Orders (TCTOs) will be done on one F-15; TCTOs will be accomplished on seven F-16s; and various mods will be done on three other F-16s. An in-depth inspection will be accomplished on one UH-1N, and a minor inspection will be done on the other UH-1N. TCTOs will be done on six F-4s, two UH-1Ns, and six T-38s. AD has projected 5,732 flying hours which will generate corresponding engine overhaul and exchangeable requirements.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: PDM will be accomplished on two F-4s. Seven F-15s are scheduled for Speedline. Seven F-16s will have the loose tail/box beam mod and other TCTO's done. One UH-1N will have on-condition maintenance (OCM), and another UH-1N will have a condition inspection. TCTOs will be done on three A-10s, seven F-4s, two F-15s, two F-111s, one UH-1N and six T-38s. AD has projected 5,238 flying hours which will generate corresponding engine overhaul and exchangeable requirements.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: PDM will be accomplished on one F-4 and two F-111s. Five F-15s are projected to go through Speedline. Two UH-1Ns will have a condition inspection done and three A-10s will have TCTOs accomplished. AD has projected 4,800 flying hours which will generate corresponding engine overhaul and exchangeable requirements.

(5) (U) Program to Completion: This is a continuing program. Continuing support will be required for assigned aircraft. Yearly costs will fluctuate depending upon flying hours, the number of aircraft due PDM, and the types and numbers of modifications being accomplished.

C. (U) Major Milestones: Not Applicable.

9. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2112, Air Force Flight Test Center (AFFTC)

A. (U) Project Description: The Air Force Flight Test Center (AFFTC), Edwards AFB, CA, conducts and supports tests of aircraft and aircraft systems, aerospace research vehicles, remotely piloted vehicles, cruise missiles and parachute delivery/recovery systems. Support for the Air Force Flight Test Center (AFFTC) aircraft located at the 6514th Test Squadron at Hill AFB, UT, is also funded within project 2112. The 6514th Test Squadron performs tests on remotely piloted vehicle systems and the Ground Launched Cruise Missile. The AFFTC currently has the following types and quantity of test/test support aircraft assigned: A-7D(9), NA-37B(3), B-1(3), B-52H(2), C-130B(2), C-130H(3), F-4C(6), RF-4C(5), F-4D(3), F-4E(10), F-15A(4), F-15B(1), F-15C(1), F-15D(1), F-16A(7), F-16B(3), F-16C(3), F-16D(1), F-111A(1); F-111D(3); F-111E(1), H-1H(2), H-3E(3), H-53C(2), O-2A(5), T-38A(23), T-46(2), and U-6(1). Total aircraft assigned: 110.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Programmed Depot Maintenance (PDM) was done on one C-130H and six F-4s; Analytical Condition Inspection (ACI) was done on one H-53 and two H-1s. Time Compliance Technical Orders (TCTOs) were done on two C-130s, three F-4Ds, nine F-4Es, three H-3s, and 13 T-38s. FALCON RALLY II/FALCON STRUCTURE was accomplished on seven F-16s. Wing foam change/TCTOs were done on one F-15C. Fire damage repairs were accomplished on an F-111D. Air Force Flight Test Center (AFFTC) flew 24,824.2 hours which generated corresponding engine overhaul and exchangeable requirements.

(2) (U) FY 1987 Program: PDM will be accomplished on one C-130B, seven F-4s, and two F-111Ds. One F-15s will receive Speedline and TCTOs. One HH-53C will go through ACI/modification. One A-37 will have ACI done, and two H-1s will have a condition inspection accomplished. TCTOs/modifications will be done on three A-7s, two C-130s, twelve F-4s, five F-16s, two H-1s, and 18 T-38s. AFFTC is projecting 24,562 flying hours which will generate corresponding engine overhaul and exchangeable requirements.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: PDM will be done on three F-4s and two F-111s. TCTOs/MODs are to be done on four A-7s, two C-130s, 20 F-4s, four F-15s, one HH-1H and two T-38s. A condition inspection will be done on one A-37 and two HH-1Hs. Air Force Flight Test Center (AFFTC) projects 22,852 flying hours which will generate corresponding engine overhaul and exchangeable requirements.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: PDM will be accomplished on two C-130s, four F-4s and one F-111. Modifications/TCTOs will be done on nine A-7Ds, one HC-130, sixteen F-4s, two F-16s and six T-38s. Four F-15s will go through Speedline, and two H-1s will have a special inspection done. AFFTC has projected 22,352 flying hours which will generate corresponding engine overhaul and exchangeable requirements.

(5) (U) Program to Completion: This a continuing program. Continuing support will be required for assigned aircraft. Yearly costs will fluctuate depending upon flying hours, the number of aircraft due PDM, and the types and numbers of modification being accomplished.

C. (U) Major Milestones: Not Applicable.

10. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2114, 4950th Test Wing

A. (U) Project Description: The 4950th Test Wing, Aeronautical Systems Division, Wright-Patterson AFB, OH, performs flight tests of aircraft and airborne systems, supports space vehicle tracking for the Space Division and other DOD and National Aeronautics and Space Administration organizations. The 4950th Test Wing currently has 38 test support aircraft assigned: C-18A(5); EC-18B(2); C-130A(2); C-135A(10); C-135E(7); C-141A(4); T-37B(1); T-39A(1); and T-39B(6).

Aeronautical Systems Division, Wright-Patterson AFB, OH, is responsible for aircraft leased to contractors, loaned to other Government agencies, or furnished to contractors under Government Furnished Property (GFP) clauses. Depending on the reason for the loan or contractural Government Furnished Property the Air Force can incur liability for the depot level maintenance (DLM) for these aircraft. The Air Force programs and pays for support of these aircraft through the 4950th Test Wing account. Based on current and projected FY 1986/87/88 contracts and agreements, AFSC is responsible for DLM costs associated with one NC-131H, one NF-111A, and one NT-33A.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Programmed Depot Maintenance (PDM) was accomplished on two C-18s, eight C-135s, and one C-141. Modifications and Time Compliance Technical Orders (TCTOs) will be done on T-39s, C-18s, C-130s, C-135s, C-141s, and the GFP NF-111A. The 4950th Test Wing flew 8,750.4 hours which generated corresponding engine overhaul and exchangeable requirements.

(2) (U) FY 1987 Program: PDM will be accomplished on one C-18, one C-130, three C-135s, and one C-141. Analytical Condition Inspection (ACI), corrosion control and life extension modification will be done on two T-39s. TCTOs/mods will be done on two C-18s, two C-130s, six C-135s, three C-141s, and one T-39B. The 4950th Test Wing anticipates flying 8,266 hours which will generate corresponding engine overhaul and exchangeable requirements.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: One C-18, one C-130, three C-135s, one C-141, and the GFP NF-111 will receive PDM. MODs/TCTOs will be done on two C-18s, one C-130, four C-135s and two C-141s. ACI/corrosion/Life Extension Mod is scheduled on two T-39s. The 4950th Test Wing is projecting 9,356 flying hours which will generate corresponding engine overhaul and exchangeable requirements.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: PDM will be done on two C-18s, four C-135s and one C-141. Modifications or TCTOs will be done on two C-130s, five C-135s, and one C-141. Two T-39s are scheduled for ACI, corrosion control and life extension modification. The 4950th Test Wing has projected 8,964 flying hours which will generate corresponding engine overhaul and exchangeable requirements.

(5) (U) Program to Completion: This is a continuing program. Continuing support will be required for assigned aircraft. Yearly costs will fluctuate depending upon flying hours, the number of aircraft due Programmed Depot Maintenance, and the types and numbers of modifications being accomplished.

C. (U) Major Milestones: Not Applicable.

11. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 65894F   Title: Real Property Maintenance Activity (RPMA)
DOD Mission Area: 472 - Real Property Maintenance   Budget Activity: 6 - Defense-wide Mission Support

1. (U) RDT&E RESOURCES PROJECT LISTING: ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		0	120,016	79,702	80,843	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This Real Property Maintenance Activity (RPMA) account provides resources for Air Force Systems Command (AFSC) owned bases for support of utility systems, maintenance, engineering services such as crash rescue, fire protection, refuse collection, snow removal, and custodial services. Also funded in this account are facility projects for maintenance, repair and minor construction work. These projects are required to preserve AF capital investments. It is necessary to sustain direct mission support facilities such as runways and taxiways, and quality of life related facilities such as dining halls, dormitories, and recreational facilities. Bases supported in this account in FY 1987 include Arnold AFS, TN; Edwards AFB, CA; Hanscom AFB, MA; Los Angeles AFS, CA; Eglin AFB, FL; and Brooks AFB, TX. This account includes three Air Force Systems Command bases providing Test and Evaluation Support in FY 1988.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	0	140,310	145,115	N/A	Continuing	N/A

(U) FY 1987 is the first year costs were identified in this program element. FY 1987 reduction reflects Congressional action. The FY 1988 reduction reflects the transfer of three bases to the O&M appropriation.

4. (U) OTHER APPROPRIATION FUNDS: Not applicable.

5. (U) RELATED ACTIVITIES: PE 65807F, Test and Evaluation, provides the mission funds for the three AFSC bases.

6. (U) WORK PERFORMED BY: The major contractors in the RPMA account are: Atlantic Personnel Services, Baltimore, MD; Powell Sanitation Services, Niceville, FL; Sylvan Service Co., Tampa, FL; and Schneider Services, Inc.

Program Element: 65894F
DOD Mission Area: 472 - Real Property Maintenance

Title: Real Property Maintenance Activity (RPMA)
Budget Activity: 6 - Defense-wide Mission Support

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 88 AND/OR FY 1989:

(U) Project: 65894F, Real Property Maintenance Activity

A. (U) Project Description: The Real Property Maintenance Activity (RPMA), account provides funding for three AFSC bases providing Test and Evaluation Support. This account funds items such as custodial services, refuse collection, building maintenance, runway and taxiway repair, and roads and grounds maintenance.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Not applicable.

(2) (U) FY 1987 Program: FY 1987 was the first year this PE was funded, providing support previously funded in PEs 65806F and 65807F.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: This is a continuing program for three bases: Eglin AFB FL, Edwards AFB CA, and Arnold AFS TN.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: This is a continuing program for three bases: Eglin AFB FL, Edwards AFB CA, and Arnold AFS TN.

(5) (U) Program to Completion: Not applicable, continuing level of effort program.

C. (U) Major Milestones: Not applicable.

9. (U) COOPERATIVE AGREEMENTS: Not applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 65896F — Title: Base Operation Support

DOD Mission Area: 473 - Base Operations — Budget Activity: 6 - Defense-wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		0	95,423	62,152	56,146	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program provides for the manpower authorizations and support for base operating activities. These include security services, accounting and finance offices, food service units, supply, administrative services and other base support units. The following bases are funded in this program in FY 1987. Arnold AFS, TN; Brooks AFB, TX; Edwards AFB, CA; Eglin AFB, FL; Hanscom AFB, MA; and Los Angeles AFS, CA. This program includes three Air Force Systems Command (AFSC) bases providing Test and Evaluation Support in FY 1988.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	0	110,268	113,618	N/A	Continuing	N/A

(U) EXPLANATION: FY 1987 is the first year costs were identified to this program element. The FY 1987 reduction reflects Congressional action. The FY 1988 reduction reflects the transfer of three AFSC bases to the O&M appropriation.

4. (U) OTHER APPROPRIATION FUNDS: Not applicable.

5. (U) RELATED ACTIVITIES: PE 65807F, Test and Evaluation provides the mission funds for the three AFSC bases.

6. (U) WORK PERFORMED BY: Primary contractors performing support in this program include United Management Service, Inc., Toledo, OH; JRW Enterprises, Portsmouth, VA; Better Service Company, Norcross, GA; and Desert Office, Lancaster, CA. These represent a broad spectrum of services provided to the Air Force Systems Command bases included in this program.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not applicable.

Program Element: 65896F
DOD Mission Area: 473 - Base Operations

Title: Base Operation Support
Budget Activity: 6 - Defense-wide Mission Support

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 65896F, Base Operation Support

A. (U) Project Description: The Base Operation Support provides funding for three AFSC bases. Included are such services as transportation, supply, security, and administration.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Not applicable.

(2) (U) FY 1987 Program: This was a new program element in FY 1987, with funds transferred from PEs 65807F and 65806F.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: This is a continuing program, providing base operating support for Eglin AFB FL, Edwards AFB CA, and Arnold AFS TN.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: This is a continuing program, providing base operating support for Eglin AFB FL, Edwards AFB CA, and Arnold AFS TN.

(5) (U) Program to Completion: Not applicable, continuing level of effort program.

C. (U) Major Milestones: Not applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 35110F — Title: Satellite Control Facility (SCF)
DOD Mission Area: 410 - Space Launch and Orbital Support — Budget Activity: 6 - Defense-Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		66,298	78,702	109,531	126,898	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The objective of this program is the maintenance of a highly reliable national satellite tracking, telemetry and commanding capability to support the development and operation of satellite systems. The Satellite Control Facility is a primary element within the Air Force Satellite Control Network (AFSCN). The AFSCN is a global network of instrumentation systems, antennas, communications, and computer systems required to support a growing inventory of increasingly complex space vehicles.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	71,259	91,714	114,794	N/A	Continuing	N/A
Aircraft Procurement	1,883	900	0	N/A	Continuing	N/A
Other Procurement	47,256	78,227	113,275	N/A	Continuing	N/A

EXPLANATION: (U) RDT&E - FY 1986 - Decrease resulted from inflation and Gramm-Rudman adjustments.
FY 1987 - Decrease is result of congressional reduction of funds. Development of space program mission unique software and modifications to the AFSCN slipped to FY 1988 and outyears.
FY 1988 - Decrease resulted from inflation and profit policy changes, the transfer of funding from another program into this program element and the rephasing of the Advanced Telemetry, Tracking and Commanding program to start in FY 1989.

(U) Other Procurement - FY 1986 - Decrease is result of adjustments made for actual obligations.
FY 1987 - Decrease resulted from congressional reduction of funds. Equipment procurement slipped into the outyears.
FY 1988 - Decrease resulted from undistributed appropriation obligation reduction based on obligation history of Air Force, from inflation and profit policy changes and from deletion of one of the Automated Remote Tracking Station program requirements. Requirement was changed from providing Global Positioning System (GPS)/AFSCN interoperability at three GPS ground antenna locations to providing interoperability at the Diego Garcia GPS location only.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

Aircraft Procurement:						
Funds	1,773	900	0	0	Continuing	N/A
Quantities	N/A					

Program Element: 35110F   Title: Satellite Control Facility
DOD Mission Area: 410 - Space Launch and Orbital Support   Budget Activity: 6 - Defense-Wide Mission Support

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
	Other Procurement:						
	Funds	42,186	48,862	92,641	53,897	Continuing	N/A
	Quantities	N/A					
	Military Construction:						
	Funds	10,555	2,600	7,500	12,820	Continuing	N/A

5. (U) RELATED ACTIVITIES: Air Force Satellite Control Network (AFSCN) and non-DCS telecommunications program activities relating to the Satellite Control Facility (SCF) are contained in PE 35151F (SCF Telecommunications). Real property maintenance activities relating to the SCF are contained in PE 35894F (Real Property Maintenance, AFSC). SCF base operating support is contained in PE 35896F (Base Operating Support, AFSC). The majority of DOD satellite programs rely, to varying degrees, on the SCF for support. The Defense Meteorological Satellite Program (DMSP), PE 35160F, and the SCF will cooperate to install an interoperable telemetry, tracking and commanding antenna at the Thule Remote Tracking Station, provide a backup control center for DMSP, and close the DMSP Loring AFB Command Readout Station. The Global Positioning System (GPS), PE 35165F, and the SCF will cooperate to assure interoperability between GPS ground antennas and SCF remote tracking stations, and provide a backup to the GPS Master Control Station at Satellite Test Center (STC). The Consolidated Space Operations Center (CSOC), newest element of the AFSCN, PE 35130F, will provide increased capability and survivability by sharing the control functions of the STC. The SCF and CSOC are providing mutual support to each other through their use of common hardware and software. Two current examples that will lead to compatibility and interoperability between these agencies are Data System Modernization (contracted by the SCF) and the Communication Upgrade (contracted by CSOC).

6. (U) WORK PERFORMED BY: Air Force management of this national capability is under Air Force Systems Command's Space Division, Los Angeles AFS, CA. Principal contractors are: Ford Aerospace Communications Corporation (FACC), Palo Alto, CA, which provides study and development analysis for the remote tracking stations; System Development Corporation Santa Monica, CA, which provides computer system integration; Space Applications Corporation, San Jose, CA, which provides systems engineering integration and test analysis; IBM Corporation, Gaithersburg, MD, which was awarded the development/acquisition contract for the Data Systems Modernization program and Command and Control Sustaining Engineering; and Ford Aerospace Communication Corporation (FACC), Sunnyvale, CA, which was awarded the development/acquisition contract for the Automated Remote Tracking Station program. In addition to RDT&E support, FACC and other contractor provide operations and maintenance support for the network.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable

Program Element: 35110F — Title: Satellite Control Facility (SCF)
DOD Mission Area: 410 - Space Launch and Orbital Support — Budget Activity: 6 - Defense-Wide Mission Support

5. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 35110F, Satellite Control Facility

A. (U) Project Description: The SCF is a world-wide network consisting of a Headquarters at Onizuka AFS, Sunnyvale, CA; seven geographically dispersed tracking stations; a communications satellite calibration site at Camp Parks, CA; and a control center (the Satellite Test Center at Onizuka AFS). The mission of the SCF is to provide tracking, real-time telemetry, and commanding of Department of Defense space vehicles operating in a multi-satellite environment. The SCF supports satellites operating with various orbital parameters to accomplish diversified test and operational objectives for the Air Force, Navy, other DOD agencies, the National Aeronautics and Space Administration, and the North Atlantic Treaty Organization. Support commences prior to launch and, in most cases, continues throughout the life of the satellite. A complex instrumentation system consisting of antennas, communications, and data processing equipment provides the ground support capabilities for the many space vehicles. The RDT&E appropriation provides for the development, installation and modification of network components to meet evolving satellite program support requirements. These efforts either correct system deficiencies or allow for increased program support.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: The Satellite Control Facility (SCF) continued its three phase upgrade to the Air Force Satellite Control Network (AFSCN). This consists of the planning, development, acquisition, operation and maintenance of systems necessary to support the needs of current and planned space programs. Data Systems Modernization on (DSM) continued development of software modules and hardware deliveries for both mission control centers and remote tracking stations. Two DSM satellite control centers were activated in FY 1986. Automated Remote Tracking Station (ARTS), Thule Tracking Station site preparation and Colorado Tracking Station construction proceeded in FY 1986. The CSOC communications contract continued to develop the communications capability for both CSOC and the SCF to insure interoperability between these two AFSCN control nodes.

(2) (U) FY 1987 Program: Ongoing efforts to meet evolving satellite program requirements will continue. The most significant portion of FY 1987 RDT&E will be the transition of operational satellite programs from the existing configuration to the new DSM configuration. The first such transition occurred in March 1986 with the last transition scheduled for September 1987. Installation and checkout of equipment in the ARTS Thule, Colorado and Northern Europe stations will continue and development, test and evaluation initiated. Communications compatibility testing will continue between the SCF and Consolidated Space Operations Center (CSOC).

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The ARTS Colorado, Thule and Northern Europe tracking stations will accomplish initial operational capability. Phase II of the ARTS program will be awarded. Communications hardware developed under CSOC will continue to be delivered to the SCF. Planning efforts for the

Project Element: 35110F Title: Satellite Control Facility (SCF)
DOD Mission Area: 410 - Space Launch and Orbital Support Budget Activity: 6 - Defense-Wide Mission Support

Advanced Telemetry, Tracking and Commanding (ATT&C) program will continue resulting in a competitive contract award in FY 1988. This will provide an extremely high frequency capability for current and future satellite vehicles. Cost estimates for ARTS and communication efforts are based on ongoing contract cost data and are predominately Category I, comprehensive estimates. Both contracts were competed.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The ARTS program will continue. ARTS will provide an internet capability between the SCF and the Global Positioning System station at Diego Garcia and modify/or begin modification of four existing satellite tracking stations and two remote satellite checkout facilities. ATT&C program will enter full development efforts. Cost estimates for ARTS are based on current contract cost data and are predominately Category I, Comprehensive estimates. Cost estimates for ATT&C are Category III, Budgetary estimates.

(5) (U) Program to Completion: This is a continuing program. The SCF will continue development of the AFSCN to support new satellite technologies and to provide the highly reliable national satellite tracking, telemetry and commanding capability. ATT&C and ARTS programs will continue.

C. (U) Major Milestones:

		Milestones		Dates
(1)	(U)	Data System Modernization (DSM) Contract Award		December 1980
(2)	(U)	DSM Military Construction		March 1983
(3)	(U)	DSM Development Test and Evaluation		October 1983
(4)	(U)	Automated Remote Tracking Station (ARTS) Contract Award		June 1984
(5)	(U)	Consolidated Space Operations Center Communications Contract Award		November 1984
(6)	(U)	DSM Operational Test and Evaluation		January 1985
(7)	(U)	Command and Control Sustaining Engineering Contract Award		January 1986
(8)	(U)	DSM Initial Operational Capability (IOC)		March 1986
(9)	(U)	ARTS-Thule Tracking Station	*September 1987	February 1988
(10)	(U)	DSM-Full Operational Capability		September 1987
(11)	(U)	ARTS-Phase II Contract Award	*October 1987	March 1988
(12)	(U)	ARTS-Colorado Tracking Station IOC		June 1988
(13)	(U)	ARTS-Northern Europe Tracking Station IOC		September 1988
(14)	(U)	ARTS-Hawaii Tracking Station - A Upgrade IOC		May 1990
(15)	(U)	ARTS-Diego Garcia Internet Station IOC	*May 1990	March 1991
(16)	(U)	ARTS-Vandenberg Tracking Station - A Upgrade IOC		May 1990
(17)	(U)	ARTS-Full Operational Capability		March 1983

* Date provided in FY 87 Descriptive Summary.

Program Element: 35110F
DOD Mission Area: 410 - Space Launch and Orbital Support

Title: Satellite Control Facility (SCF)
Budget Activity: 6 - Defense-Wide Mission Support

(U) Explanation of Milestone Changes

(9) (U) ARTS Thule Tracking Station IOC slipped to February 1988 to incorporate two previously unidentified requirements into the ARTS design.

(11) (U) Phase II Contract award date slipped to March 1988 because of need to operationally demonstrate ARTS Phase I design prior to Phase II contract award.

(15) (U) ARTS Diego Garcia Internet Station IOC slipped to March 1991 because Congress delayed FY 1987 Military Construction Funds until FY 1988.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 35119F
DOD Mission Area: 410 - Space Launch and Orbital Support

Title: Space Boosters
Budget Activity: 6 - Defense-wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		301,562	274,379	246,641	15,847	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: National security requirements dictate a continuing, highly reliable means of placing critical Department of Defense (DOD) satellites into their required orbits. Assured access to space, directed by the President in the National Security Launch Strategy, will be accomplished through the use of a robust mix of Expendable Launch Vehicles (ELVs) in this program and by the Space Transportation System. The Space Boosters program provides for development, procurement and launch of DOD ELVs, including the Titan IV, Titan 34D, and the Delta II (formerly the Medium Launch Vehicle) at Cape Canaveral AFS, Florida, and Titan IV, Titan 34D, Titan II Space Launch Vehicle (SLV) and Atlas E at Vandenberg AFB, California. Procurement of 23 Titan IVs, development and modification of 16 Titan II SLVs, and development and procurement of up to 20 Delta II's are ongoing. This program also provides for a dual launch capability for the Titan IV at Vandenberg AFB, engineering support of active launch programs and post-flight assessment of DOD ELVs to maintain their high demonstrated reliability. To continue the "assured access to space strategy" in the future, the program plans to focus technologies leading to development of a heavy lift unmanned cargo vehicle for the late 1990's, designed to satisfy future Air Force, Strategic Defense Initiative and other national needs for more economical space transportation.

3. (U) COMPARISON WITH FY 87 Descriptive Summary: ($ in thousands)

RDT&E	215,751	138,690	118,310	N/A
Missile Procurement	120,194	282,747	348,831	N/A

EXPLANATION: (U) The FY 1986 RDT&E increase of $85.8 million is the net result of a $94.0 million increase for the FY 1986 Urgent Supplemental to support the Space Recovery Program and a $8.2 million decrease to reflect Gramm-Rudman-Hollings reductions and other adjustments. The FY 1987 RDT&E increase of $135.7 million is the net reult of a $142 million is the net result of a $142.0 million increase for the Urgent Supplemental to support the Space Recovery Program and a $6.3 million decrease associated with Congressional undistributed adjustments. The FY 1988 RDT&E increase of $128.3 million reflects a realignment between the RDT&E and Missile Procurement appropriations associated with the Titan IV contract. Missile procurement additions in FY 86 and 87 of 234.7 million and $424 million were included in the Urgent Supplemental for production and launch rate enhancements for 13 additional Titan IV boosters and the first 7 Delta II's. The FY 88 missile procurement increase continues Titan IV and Delta II production.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Missile Procurement	348,543	669,267	672,312	458,006	Continuing	N/A
Quantities - Titan IV*	0	1	4	3		
- Titan II SLV **	0	0	5	0		
- Delta II ***	0	6	7	6		

* Additional vehicles will be funded by a classified program.
** Defense Meteorological Satellite Program production boosters only. Eight are funded in other program elements.
*** One R&D funded booster is also included in the program in FY 87.

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Operation & Maintenance	115,985	108,565	165,763	242,354	Continuing	N/A
Military Construction	0	0	0	30,000	190,000	210,000

5. (U) RELATED ACTIVITIES: Major DOD and other space systems that employ the Titan, Delta II, and Atlas boosters include classified space programs, Defense Satellite Communications System (PE 33110F), the Global Positioning System (PE 35165F), Defense Meteorological Satellite Program (PE 35160F), Defense Support Program (PE 12431F), Milstar (PE 33603F), Space Test Program (PE 63402F) and the National Oceanic and Atmospheric Administration polar orbiting meteorological satellites. Titan 34D vehicles launched from Vandenberg AFB are funded by a classified program element, but the operation is managed under this program.

6. (U) WORK PERFORMED BY: The responsible Air Force agency is Air Force Systems Command's Space Division, Los Angeles AFS, CA. Systems Engineering is provided by the Aerospace Corporation, El Segundo, CA. Titan 34D, Titan II Space Launch Vehicle (SLV) and Titan IV contractors include Martin Marietta Corporation Denver, CO (core vehicle, Transtage, Titan II, Titan IV); Aerojet Liquid Rocket Company, Sacramento, CA (liquid rocket engines); United Technologies Corporation, Chemical Systems Division, Sunnyvale, CA (Titan 34D and Titan IV solid rocket motors); General Motors Corporation, Delco Electronics Division, Santa Barbara, CA (guidance); General Dynamics, Convair Division, San Diego, CA (Centaur Upper Stage); Boeing Aerospace Corporation, Seattle, WA (Inertial Upper Stage). Delta II contractors include McDonnell Douglas Astronautics Corportation, Huntington Beach, CA (prime contractor); Rockwell International Corporation, Rocketdyne Division, Canoga Park, CA (stage 1 rocket engines); Aerojet Liquid Rocket Company, Sacramento, CA (stage 2 rocket engines); General Motors Corporation, Delco Electronics Division, Santa Barbara, CA (guidance); Morton Thiokol Corporation, Huntsville, AL and Elkton, MD (solid rocket motors); Hercules Corporation, Magna, UT (solid rocket motors). Atlas contractors include General Dynamics, Convair Division, San Diego, CA (integration and

airframe) and Rockwell International, Rocketdyne Division, Canoga Park, CA (rocket engines).

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 35119F, Space Boosters

A. (U) Project Description: The Department of Defense family of space boosters (Titan, Atlas, Thor, Delta) was developed to provide a versatile capability for meeting national launch requirements. This family of expendable launch vehicles (ELVs) includes decommissioned ballistic missiles (Titan II, Atlas-E and Thor vehicles) upgraded for space launch, as well as boosters designed solely for space launch. The need for a mixed fleet for assured access to space was reinforced by the loss of Space Shuttle launch capability for a minimun of 24 months. To prevent a launch shortfall in the future, the DOD will rely on a robust mixed fleet with ELVs capable of supporting small, medium and large payloads. This program element contains development resources for DOD ELVs, as well as procurement of boosters for Air Force missions. Other users reimburse the program for services provided to non-Air Force programs. Continuing support is provided within the Space Boosters program for the currently and soon to be operational Atlas, Delta, and Titan ELVs, and storage for the nine remaining Thors. Specifics on space boosters included in this program are as follows:

(1) (U) Thor - refurbished Thor Intermediate Range Ballistic Missile, programmer guided, liquid rocket engine, single stage. Nine vehicles in storage at Norton AFB, CA. Not an active launch program.

(2) (U) Atlas-E - refurbished Atlas ballistic missile, radio guided, with liquid propellant rocket engine, launched from Vandenberg AFB to low earth orbit; capacity of 1,750 pounds to a 100 mile polar orbit.

(3) (U) Titan 34D/Transtage - liquid rocket engine powered core vehicle, with two strap-on solid rocket motors, Transtage upper stage, and an inertial guidance system. Launched from Cape Canaveral AFS, FL, primarily to geosynchronous orbit with a capacity of 4,100 pounds to geostationary altitude or 33,800 pounds to a 100 mile orbit.

(4) (U) Titan 34D/RGS - radio guidance system version of the Titan 34D without an upper stage, launched from Vandenberg AFB, CA, to low polar earth orbit, with a capacity of 27,600 pounds to 100 miles altitude.

(5) (U) Titan IV - modified version of the Titan 34D, formerly known as the Titan 34D7 Complementary ELV, with longer strap-on solid rocket motors, using a modified Centaur G-prime or Inertial Upper Stage, to be launched from Cape Canaveral AFS, FL, for geosynchronous missions and from Vandenberg AFB, CA, for low polar missions. Capacity of 10,200 pounds to geostationary altitude or 31,100 pounds to low polar earth orbits. With the National Aeronautics and Space Administration's cancellation of the Centaur Upper Stage program on the Space Shuttle, the Titan IV is the free world's largest capacity space booster, and the only means of providing launch capability above 5000 pounds to geosynchronous orbit.

(6) (U) Titan II Space Launch Vehicle (SLV) - refurbished ICBM, inertial guidance, and liquid rocket engine, to be launched from Vandenberg AFB, CA for small, low polar orbiting payloads. Capacity of 2,600 pounds to 450 miles or 4,200 pounds to a 100 mile altitude polar orbit.

(7) (U) Delta II - Modified version of a Delta launch vehicle, with upgraded strap-on solid rocket motors, and lengthened first stage. The Delta II was selected as the winner of the Air Force's Medium Launch Vehicle competition in Jan 87. Delta IIs will be able to place 4220 pounds into circular, inclined orbits of 10,898 miles altitude. The Delta II appears to also offer an internationally-compatitive means of satisfying commercial launch requirements by adapting the design to private sector satellites on a commercial basis.

(U) In addition to development and procurement of space launch vehicles for the DOD, the Space Boosters program includes post flight analysis, study, modification, redesign and test to correct deficiencies; evaluation and improvement for mission reliability; component reliability improvement to prevent launch vehicle failures; and analysis support and development planning for new missions on these boosters. The operation and maintenance funds in the program provide for refurbishment tasks for the Titan II Space SLV, launch services for the Atlas E and Titan II SLV at Vandenberg AFB, and launch services for the Titan/Transtage, Titan IV and Delta II at Cape Canaveral AFS. The military construction funds are for a second Titan IV launch complex at Vandenberg AFB.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Titan and Atlas reliability maintenance, flight assessment, vendor qualification and component/subsystem replacement efforts continued. Following the space shuttle Challenger accident in January, the DOD recommended a reassessment of space launch policy to include increased reliance on expendable boosters and dual launch compatibility for critical satellite programs. Approval of Titan IV multi-year procurement, and funding for increased procurement, launch rate enhancement, expansion to a dual-coast launch capability for the Titan IV, and procurement of a competitively-chosen MLV (now the Delta II) for GPS satellite launches were included in a FY 86 urgent supplemental. A Titan mission, launched from Vandenberg AFB on April 18, exploded above the launch pad shortly after lift-off. This catastrophic event caused extensive damage to the Titan launch facilities. The urgent supplemental also provided funding for launch complex repairs, which were completed at the end of the fiscal year. The Titan program instituted a recovery effort to develop, validate and employ state-of-the-art non-destructive test techniques for large solid rocket motors. This process delayed other scheduled FY 1986 Titan 34D launches into FY 1987 and FY 1988. Two Atlas-E boosters were successfully launched during the year. One Atlas-H was successfully launched from Vandenberg for a classified user. Technical oversight was also provided by the program for one NASA Scout launch of an Air Force Instrumented Test Vehicle payload. The Titan IV program continued on schedule for an October 1988 Initial Launch Capability (ILC). System preliminary design review and critical design review were completed. Some impact is expected to the upper stage portion of the program due to termination of the shuttle version of the Centaur Upper Stage by the National Aeronautics and Space Administration. The Titan IV Centaur relied on initial development accomplishments in the Centaur program for the Space Shuttle. Development efforts for the conversion of surplus

Titan IIs to a space launch vehicle (SLV) configuration were initiated. A full and open competition for the Medium Launch Vehicle (MLV) began and four contracts for a preliminary design were awarded.

(2) (U) FY 1987 Program: Titan and the Atlas reliability maintenance, flight assessment, component and subsystem replacement efforts and vendor qualification will continue. Titan IV, and Titan II SLV production will continue. The MLV first phase was completed in December 1986. The second phase procurement process was completed with a contract award in January 1987 to McDonnell Douglas Astronautics Corporation for the Delta II. The basic contract is for one research and development booster and six production boosters. Contract options provide for procurement of up to thirteen additional production boosters for a total of twenty. The contract provides for seven Navstar GPS launches per year beginning in October 1988. This is an increase from the four per year requested at the time of the urgent supplemental when the first Shuttle flight was scheduled for July 1987. The Congress recognized that additional expendable launch vehicles "would be required if Shuttle availability is delayed even further." (Senate Report 99-301.) Now that the first Shuttle flight is delayed until at least February 1988, further augmentation of Navstar GPS launches by the Delta II is necessary. Fortunately, the contracted cost of the Delta II permits purchase of seven in FY 87 (including one R & D vehicle), seven in FY 88, and six in FY 89 for the funds originally assumed to be required for only four per year. Three Atlas launches are planned which include estimates for vehicles subject to launch on demand. The Titan 34D system will resume launches. The last Titan 34D/Radio Guidance System launch from Vandenberg AFB, CA, is scheduled during this year.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The Titan and the Atlas reliability maintenance, flight assessment, component and subsystem replacement efforts and vendor qualification will continue. The final Titan 34D/Transtage launch from Cape Canaveral AFS, FL is scheduled during this year. Development of the Titan IV/Inertial Upper Stage capability will be completed and Centaur upper stage development will continue, requiring the bulk of FY 88 RDT&E funds. The Delta II and Titan II SLV will also require RDT&E funding to complete development. Production of the Titan IV and Titan II SLV will continue, with an FY 1988 ILC for the Titan II. Planning for a dual West Coast launch capability for the Titan IV will begin. Procurement of the Delta II will continue. The first Titan IVs and Titan II SLVs will be delivered during the year. In FY 1988, two Atlas launches and three Titan launches are planned. Cost estimates for the Space Boosters program are based on a large historical data base, contractor estimates and program office cost models. Cost estimating Category II, mature estimates, applies. Contract award prices, with priced options, provide a basis for this program's budget. The program is in production for the Titan IV, Delta II and Titan II SLV while production has ceased for the other boosters and completed launch vehicles are awaiting launch.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The Titan and the Atlas reliability maintenance, flight assessment, component and subsystem replacement efforts and vendor qualification will continue. The final Atlas E launch from Vandenberg AFB, CA is scheduled during this year. Production of the Titan IV and Delta Delta II will continue, with ILCs for both during the year. Procurement of Titan II SLVs will continue. In FY 1989, two Atlas launches, six Delta II launches and three Titan IV launches are planned. Since the major development work will be accomplished for the Titan IV, Titan II SLV and Delta II, RDT&E funding levels decrease for the program. Cost estimates for the Space Boosters program are based on a large historical data base, contractor estimates and program

office cost models. Cost estimating Category II, mature estimates, applies. Contract award prices, with priced options, provide a basis for this program's budget. The program is in production for the Titan IV, Delta II and Titan II SLV while production has ceased for the other boosters and completed vehicles are awaiting launch.

(5) (U) Program to Completion: This is a continuing program necessary to provide assured access to space for the nation's critical space systems. Titan, Delta II and Atlas reliability maintenance, flight assessment, vendor qualification, and component/subsystem replacement efforts will continue until all vehicles have been launched. The program will continue to require funds from other appropriations to support space booster launches, to maintain critical booster support capability, and to phase out certain space booster configurations. Acquisition of the Titan IV will continue, leading to launch of an average of five boosters per year. The Titan II SLV will continue conversions leading to delivery and launch of an average of two boosters per year. The Delta II will continue with procurement necessary to support Global Positioning System launch requirements.

C. (U) Major Milestones:

	Milestones	Dates
(1) (U)	First Titan III launch	July 1966
(2) (U)	First converted Atlas F launch	January 1967
(3) (U)	100th Titan III launch	December 1976
(4) (U)	Last Thor launch	June 1980
(5) (U)	First converted Atlas E launch	December 1980
(6) (U)	Thor space launch capability terminated	May 1981
(7) (U)	Last Atlas F launch	June 1981
(8) (U)	First Titan 34D/Inertial Upper Stage launch at Cape Canaveral AFS, FL	October 1982
(9) (U)	First Titan 34D/RGS launch at Vandenberg AFB, CA	June 1983
(10) (U)	Titan 34D production terminated	June 1983
(11) (U)	First Titan 34D/Transtage launch at Cape Canaveral AFS, FL	January 1984
(12) (U)	300th Titan family booster launch	August 1984
(13) (U)	Initiate Titan IV acquisition	February 1985
(14) (U)	Initiate Titan II Space Launch Vehicle acquisition	January 1986
(15) (U)	Last scheduled Titan 34D launch from Vandenberg AFB, CA	FY 1987
(16) (U)	Last scheduled Titan 34D launch from Cape Canaveral AFS, FL	FY 1988
(17) (U)	Titan II Space Launch Vehicle initial launch capability (ILC) at Vandenberg AFB	April 1988
(18) (U)	Titan IV ILC at Cape Canaveral AFS, FL	October 1988
(19) (U)	Delta II ILC at Cape Canaveral AFS, FL	October 1988

Program Element: 35119F
DOD Mission Area: 410 - Space Launch and Orbital Support

Title: Space Boosters
Budget Activity: 6 - Defense-wide Mission Support

(20) (U)	Titan IV ILC at Vandenberg AFB, CA		January 1989
(21) (U)	Last Atlas E launch from Vandenberg AFB, CA	*(FY 1990)	FY 1989

* Date presented in FY 1987 Descriptive Summary

(U) Explanation of Milestone Changes

(19) (U) Medium Launch Vehicle capability added in FY 1986 Urgent Supplemental
(20) (U) Additional Titan IV capability added in FY 1986 Urgent Supplemental
(21) (U) Atlas E program terminated one year earlier for cost savings

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 35130F
DOD Mission Area: 410 - Space Launch and Orbital Support

Title: Consolidated Space Operations Center (CSOC)
Budget Activity: 6 - Defense-Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT (PE)		79,732	71,173	50,020	39,126	69,613	485,955

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Consolidated Space Operations Center (CSOC) program element (PE) funds the development, acquisition, and operation of a major facility for the planning, coordination and execution of Department of Defense (DOD) space operations. The PE funds land acquisition, utilities development, and construction of four major structures for operations, operations support, power production, engineering and administration. The CSOC, located at Falcon Air Force Station (FAFS), CO, will function as a major operational control center within the Air Force Satellite Control Network (AFSCN), a worldwide configuration of space-ground link resources consisting of Remote Tracking Stations (RTSs), communications and control centers. The CSOC is comprised of a Satellite Operations Complex (SOC) as the main functional element plus four additional segments that will collectively provide the required support capabilities. These support segments are a Communications Segment (CS), a Facilities Segment (FS), a Network Control Segment (NCS) and a Support Segment (SS). The SOC will plan and execute control of operational satellites. The CS consists of terrestrial and satellite communications circuits and equipment required for internal CSOC operations and external mission-related interfaces. The FS provides buildings, roads, utilities, parking and other real property-type items for the CSOC and other on-site operations. The NCS schedules, coordinates and controls the resources of the AFSCN and is interoperable with a similar activity at the Satellite Test Center (STC) in Sunnyvale, CA. The SS includes the Security Control Subsystem, a Weather Support Unit, the Timing Subsystem, the Operations Command Center, a Technical Data Center and a Training Element. The CSOC will correct vulnerability, electronic privacy and capacity deficiencies in the existing satellite control architecture. The STC poses a potential single point failure in the existing common user satellite control network. The STC is vulnerable to hostile man-made and local environmental threats. The civil and industrial communities have closely encircled the STC, impairing physical security electronic privacy and facility expansion. The CSOC program corrects these deficiencies primarily by siting its facility in an undeveloped locale of an environmentally stable region, geographically separated from the STC.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
RDT&E	85,187	93,664	66,649	N/A	120,498	542,686
Other Procurement	23,695	85,542	28,930	N/A	39,124	408,381

EXPLANATION: (U) RDT&E: FY 1986 funding decrease (-$5.455 million) reflects primarily Gramm-Rudman reductions. FY 1987 funding decrease (-$22.491 million) reflects FY 1987 Congressional reductions. Funding changes in FY 1988 reflect deletion of funds for continued Shuttle Operations and Planning Complex (SOPC) development. Other Procurement: FY 1986 through FY 1988 funding changes resulted from a combination of Gramm-Rudman reductions, pricing updates, projected actual repricings, FY 1987 Congressional reductions (-$8.315 million), spares adjustments and deletion of SOPC funding. The Secretary of Defense and the Secretary of the Air Force have confirmed the decision to terminate SOPC development.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

Other Procurement						
Funds	21,111	71,094	9,332	8,802	14,722	354,583
Quantities			Not Applicable			

5. (U) RELATED ACTIVITIES: Program management is funded through PEs 65806F and 72806F, Acquisition and Command Support. PE 33112F, AF Communications, and 33126F, Long Haul Communications, provide administrative communications and support to operational communications. PE 35110F, Satellite Control Facility, funds the Colorado Tracking Station, collocated at Falcon AF Station (FAFS) and the Data System Modernization project which develops the Consolidated Space Operations Center (CSOC) satellite control equipment. Air Training Command participation in the CSOC operations training program is supported by parts of PEs 84731F, General Skill Training; 84772F, Training Development; and 85796F, Base Operations (Training). Base operations support is funded by PE 12496F, Base Operations-AFSPACECOM. Logistics support is provided by PE 71112F, Inventory Control Point Operations. Utilities and facilities maintenance are included in PE 12894F, Real Property Maintenance. PE 35165F funds the Global Positioning System Master Control Station collocated at Falcon AF Station. PE 33603F funds development, Initial Operational Test and Evaluation and operation of the Milstar Master Control Station also collocated at Falcon AFS. Funding and manning in PEs 12891F, Commissary Retail Sales, and 87792F, Station Hospitals/ Medical Clinics, have been increased to service CSOC personnel. Additionally, there are several Collocated Program Elements (CPEs) that relate to the CSOC mission and are located at FAFS. The CPEs utilize CSOC's support capabilities, but are not a direct part of the CSOC acquisition. These CPEs include the Colorado Tracking Station (CTS), the Global Positioning System (GPS) master control station, the Milstar master control station, and a Defense Satellite Communications System (DSCS) communications terminal.

6. (U) WORK PERFORMED BY: The CSOC System Program Office (SPO) is located at the Air Force Systems Command's Space Division, Los Angeles, CA. The Army Corps of Engineers, Omaha, NE, is responsible for managing the construction of the CSOC facilities. The Aerospace Corp, El Segundo, CA, provides the SPO with system engineering services and TRW, Inc., Redondo Beach, CA, provides CSOC system integration services. The satellite control systems are being developed and produced by IBM at their Gaithersburg, MD, facilities. The communications system is being developed by Space Communications Company, Gaithersburg, MD. The facilities design work was completed by Holmes & Narver, Orange, CA. Schmidt-Tiago, Colorado Springs, CO, completed site preparation work, and Bechtel National Inc., San Francisco, CA, constructed the CSOC facilities. Lockheed Space and Missile Company, Sunnyvale, CA and INFOTEC Corp, Costa Mesa, CA were awarded contracts to provide positional training for CSOC personnel.

ogram Element: 35130F Title: Consolidated Space Operations Center (CSOC)
Mission Area: 410 - Space Launch and Orbital Support Budget Activity: 6 - Defense-Wide Mission Support

(U) PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable

(U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 35130F, Consolidated Space Operations Center (CSOC)

A. (U) Project Description: Development and activation of CSOC occurs in several phases. Each phase will result ı an increment of added operational capability. CSOC facilities were available for occupancy in October 1985. :ilities and communications are operational and supporting the Global Positioning System Master Control Station, ЅOC's first operational capability. The first and second satellite Mission Control Centers (MCCs) are projected to ։ operational in September 1987 and May 1988, respectively. The CSOC Network Control Segment and its assigned people ill be fully functional and certified for range control, scheduling operations and scheduling interoperability with the ir Force Satellite Test Center (STC) in December 1987. Development of the Shuttle Operations and Planning Complex SOPC) in the CSOC has been terminated.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: The CSOC facilities work tailed-off in FY 1986. Major FY 1986 tasks ncluded production, installation, integration and test of operational systems. Systems in production include atellite control hardware and software, operational communications, and resource scheduling and control. Several upport components such as the Security Control Subsystem, the Timing Subsystem and the Operation Command Center are lso in production. Integration and test of the first MCC system began in FY 1986. The operations training program ontinues to run at surge capacity in order to prepare the operations and maintenance personnel for the pending initial perational capability (IOC) of the Satellite Operations Complex (SOC).

(2) (U) FY 1987 Program: The CSOC facilities work will be completed during FY 1987. Installation, ntegration and test of control and support systems for the first MCC will continue throughout FY 1987. This activity ill support an IOC to control Global Positioning System and Defense Support Program satellites in September 1987. This ffort will also support the incremental addition of control capability for the Defense Meteorological Satellite rogram with an IOC in FY 1988. Installation, integration and test of control and support systems for the second MCC ill begin in FY 1987 to support a May 1988 IOC. Operations personnel training will continue with positional ualification through team-level rehearsal.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Operational testing of the second Mission Control Center (MCC) technical systems will continue, supporting the scheduled May 1988 initial operational capability date. These tests, using Data System Modernization hardware and software, will demonstrate the MCC's ability o track, monitor and command military communications satellites such as the Defense Satellite Communications System (DSCS) satellites, the Fleet Satellite Communications System (FLTSATCOM) satellites and the North Atlantic Treaty Organization (NATO) II and III satellites. The first MCC operations will be expanded to include operations for the Defense Meteorological Satellite Program. Development of software required for range control and scheduling will be

completed and operational testing will begin. The CSOC Network Control Segment and its assigned personnel will become fully operational and certified for range control, scheduling and scheduling interoperability with the Satellite Test Center (STC) at Sunnyvale AFS, CA. Due to the maturity of the FY 1988 planned program, the cost estimates are predominantly Category I, Comprehensive estimates.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The Consolidated Space Operations Center (CSOC) communications system will be expanded to include direct duplex high data rate communications between CSOC and elements of the Air Force Satellite Control Network (AFSCN), communications nets for the Operations Command Center, installation and checkout of the Network Control Segment and the Timing Subsystem, and upgraded communications for the CSOC Weather Support Unit. Sustaining Satellite Operations Complex (SOC) training will continue through FY 1989. Due to the maturity of the FY 1989 planned program involving primarily software development and modification and expansion of the communications system, the cost estimates are Category I, Comprehensive estimates, and Category II, Mature estimates.

(5) (U) Program to Completion: Acquisition, integration and test of technical systems in support of CSOC satellite operations will continue throughout the Five Year Defense Plan. With the activation of the second MCC, the emphasis of RDT&E activities shifts from satellite control to completion of the communications system and integration of CSOC into the AFSCN. The RDT&E portion of this program element is anticipated to be completed in early CY 1993.

C. (U) Major Milestones:

Milestones		Dates
(1) (U) Mission Element Need Statements Validated		September 1979
(2) (U) Environmental Impact Analysis Filed		February 1981
(3) (U) Site Selection Announcement		March 1981
(4) (U) Construction Start		May 1983
(5) (U) Facility Occupancy		October 1985
(6) (U) Global Positioning System Master Control Station Operational		January 1986
(7) (U) First Satellite Mission Control Center Operational	*(February 1987)	September 1987
(8) (U) Second Satellite Mission Control Center Operational		May 1988

*Date presented in FY 1987 Descriptive Summary

(U) Explanation of Milestone Changes:

(7) (U) Operational date for first Mission Control Center (MCC) slipped 6 months due to program rephase dictated by fiscal constraints.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 35160F
DOD Mission Area: 410 - Space Launch and Orbital Support

Title: Defense Meteorological Satellite Program (DMSP)
Budget Activity: 6 - Defense-Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		51,276	61,169	56,181	68,539	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Operational commanders in all Services require timely, quality weather information to effectively employ weapon systems and protect DOD resources. The Defense Meteorological Satellite Program is the DOD's most important single source of weather data. Program requirements were revalidated by the Joint Chiefs of Staff in August 1986. The operational Commanders-in-Chief continue to strongly state their requirement for an operational DMSP in their semiannual situation reports. This Program Element provides the satellites and sensors, command and control, Air Force strategic data processing and fixed and mobile tactical data receipt and processing terminals, and operations and maintenance.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	54,874	63,772	60,532	N/A	Continuing	N/A
Missile Procurement	40,979	19,427	89,625	N/A	Continuing	N/A
Other Procurement	14,469	6,348	11,561	N/A	Continuing	N/A

EXPLANATION: (U) RDT&E funds were reduced in FY 1986 by Gramm-Rudman-Hollings reductions, in FY 1987 by general RDT&E reductions and in FY 1988 due to higher Air Force priorities. Missile procurement funds were reduced in FY 1986 by Gramm-Rudman-Hollings reductions, in FY 1987 by general reductions, and were increased in FY 1988 to initiate a multi-year procurement of primary sensors similar to that done in FY 1983 and FY 1985. Other procurement funds were reduced in FY 1986 by Gramm-Rudman-Hollings reductions and higher Air Force priorities, and in FY 1987 and FY 1988 by general reductions.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands):

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Missile Procurement:						
Funds	38,713	18,872	97,446	212,113	Continuing	N/A
Quantities	0	0	0	2		
Other Procurement:						
Funds	10,179	3,377	10,374	22,954	Continuing	N/A
Quantities	Not Applicable					

5. (U) RELATED ACTIVITIES: The Defense Meteorological Satellite Program is a joint-Service program in accordance with the Joint-Service Memorandum of Agreement on the Management and Operation of DMSP. Based on the successful operation of an experimental receiving and data processing terminal aboard the U.S.S. Constellation, the Navy has equipped eight aircraft carriers to receive DMSP data and is operating two shore based terminals. PE 35160N provides funding to the DMSP program office. Seventy-two SMQ-11 shipboard and shore terminals are under development by the Navy. Through the DMSP program office, the Marine Corps has procured one RDT&E and six production models of the new Air Force developed transportable terminal, with five additional planned. Navy personnel are integrated into the program office to insure compatibility between the Air Force developed satellites and the receiving and data processing equipment of the Navy and Marine Corps. A Special Assistant for Air Force/Army represents these Service users within the program office. Close coordination is also maintained with the civilian polar-orbiting weather satellite program operated by the Department of Commerce (DOC). The two systems have different primary missions and different primary sensors. Cloud imagery is the primary DOD need, while vertical temperature and moisture soundings are the primary DOC needs. Interchange of technology and joint studies have been continuous, with special emphasis on avoiding duplication of effort. Pursuant to a study directed by the Office of Management and Budget, DOC was directed in January 1974 to adopt the DOD spacecraft design, the Block 5D, as the basic spacecraft bus for the civil system. Atlas E and Titan II launch services for the DMSP are provided by the Space Boosters Program (PE 35119F). Leased communications are provided for the DMSP command, control and communication segment by DMSP Communications (PE 35162F). The DMSP and the Air Force Satellite Control Facility (PE 35110F) are cooperating to install an interoperable telemetry, tracking, and control antenna at the Thule Remote Tracking Station via the Automated Remote Tracking Station program. This initiative, in conjunction with other command and control upgrades, will allow closure of the dedicated DMSP Command Readout Station at Loring AFB, ME in FY 1988. DMSP sensor demonstrations are flown in conjunction with the Space Test Program (PE 63402F). Strategic data processing upgrades such as the Automated Weather Distribution System (AWDS) product driver at Air Force Global Weather Central are jointly funded with Air Weather Service (PE 35111F).

6. (U) WORK PERFORMED BY: Development and procurement are managed by Space Division, Los Angeles AFS, CA. The Air Force Geophysics Laboratory, Hanscom AFB, Bedford, MA; the Aerospace Corporation, El Segundo, CA; and the Naval Research

Laboratory, Washington, DC, all contribute to DMSP program development. Contractors include: RCA, Princeton, NJ (spacecraft and satellite integration); Westinghouse Electric Corporation, Baltimore, MD (primary imaging sensor); Hughes Aircraft Company, Los Angeles, CA (mission sensors); Aerojet Electro-systems, Azuza, CA (mission sensors); Harris Corporation, Melbourne, FL (ground command and control and data processing); and American Satellite Corporation Rockville, MD (commercial communications data relay under PE 35162F).

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 35160F, Defense Meteorological Satellite Program:

A. (U) Project Description: The DMSP is a joint-Service program which supports all military Services. The DMSP provides visible and infrared cloud cover data and other meteorological, oceanographic, and solar-geophysical information. These data are required over the entire surface of the earth in support of strategic and tactical missions. At least two satellites are required in sun synchronous polar orbit at all times, each giving coverage of the whole earth every 12 hours. (Sun synchronous means that the satellite crosses the equator, going north, at the same local time on each of its 14 orbits/day.) Typically, the DMSP has one satellite that crosses the equator in the early morning and a second satellite that crosses the equator in late morning. This Program Element provides the satellites and sensors; ground command and control facilities and personnel; Air Force fixed and mobile tactical data receipt and processing terminals; and operations and maintenance. The Navy, under PE 35160N, is equipping 72 ships and shore stations to receive DMSP data. The Air Force began procurement of new tactical terminals (Mark IVs) in FY 1978 with the acquisition of one RDT&E model and three production models that have been operationally deployed. Air Force follow-on production procurement of six terminals will end in FY 1987. These six terminals will replace six Mark IIA and III terminals procured in the 1960s, that are currently deployed worldwide. The remaining seven fixed sites will be extensively modified and upgraded with Mark IV components. The Marine Corps, through the DMSP program office, has procured one RDT&E Mark IV and six production units. Five more are planned. In FY 1986, Congress approved the continued use of expendable launch vehicles (ELV) for DMSP Block 5D satellites. The directed ELV is the Titan II Intercontinental Ballistic Missile being removed from operational status. The use of Titan II as a launch vehicle will cover mission replenishment needs at a large cost savings and with great operational efficiency through the late 1990's. DMSP Block 5D satellites will launch on Atlas E launch vehicles through FY 1989 and transition to Titan II in FY 1990.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: The Defense Meteorological Satellite Program (DMSP) continued the efforts begun in previous years. The Block 5D-3 Titan II-compatible satellite began development after contract award in July 1986. This final evolution of the Block 5D design has increased survivability and increased power capability to meet the DOD payload requirements of the 1990's. Effort began on the refurbishment of the first Titan II booster for DMSP. Study of an active laser radar light detection and ranging (LIDAR) sensor that will ultimately measure wind speed and atmospheric aerosol content continued. Work done in earlier years to develop satellite computer software to

improve satellite autonomy allowed incorporation of autonomous operation capabilities to begin on Block 5D-2 satellites. The satellite laser survivability effort continued as did the production efforts begun in earlier years. These include the multi-year procurement of four satellites begun in FY 1983 and 1985 which is on cost and schedule track, the command control system upgrades (shared Thule command and control facility and the hardened satellite operations center near Fairchild AFB, WA), and the microwave moisture sounder. In FY 1986 strategic data processing upgrades continued and the Satellite Data Handling System (SDHS) at Air Force Global Weather Central (AFGWC) became operational. Also a Marine Corps Mark IV tactical terminal completed a successful deployment to Antarctica.

(2) (U) FY 1987 Program: The majority of the FY 1987 DMSP program continued efforts begun in prior years. The prototype Titan II booster refurbishment continued. The first Block 5D-3 satellite completed development and began subsystem level test in preparation for sensor integration and the start of system level tests in FY 1989. The laser survivability development and light detection and ranging (LIDAR) sensor study continued. The multi-year procurement of four satellites begun in FY 1983 and 1985 continued, with the first satellite to be delivered in FY 1988. Procurement of the command and control hardware for the hardened satellite operations center near Fairchild AFB, WA continued. The shared Thule command and control facility effort continued as did microwave sounder production. The Air Force Mark IV mobile tactical terminal production was completed in FY 1987. Upgrades continued to the strategic data processing and handling capability at Air Force Global Weather Central.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The majority of the FY 1988 RDT&E effort will be a continuation of efforts begun in prior years. The first Block 5D-3 satellite will continue in subsystem level testing. Laser survivability and LIDAR sensor efforts will continue. Command and control system upgrades will continue with the hardened satellite operations center nearing its FY 1989 completion. The shared Thule command and control facility will be completed and the DMSP Loring AFB, ME Command Readout Site will be closed. In addition, all mobile tactical terminals will be EMP hardened against Electromagnetic Pulse (EMP) and upgraded to process DMSP data beyond the current cloud imagery, a capability which is critically needed by tactical forces. A multi-year procurement (MYP) will be initiated in FY 1988 similar to the previous highly successful DMSP MYP of Block 5D-2 Satellites S11-S14. This MYP will be for the last five DMSP Block 5D-3 satellites, S16-S20. In FY 1988, DMSP will procure two primary sensors and expanded advanced material buy for economic order quantities, funded to termination liability, for three additional sensors to follow in FY 1990. Spacecraft procurement will start in FY 1989. These two follow-on MYP contracts will save $90 million over the traditional fully funded approach, effectively providing five satellites for the price of four. In FY 1988, DMSP will award four competitive concept studies for the DMSP follow-on Block 6 satellites which will be needed to meet on-orbit requirements in the late 1990's. Objectives include lowering life cycle cost through a competitive design to cost approach, upgrading 1970's Block 5D technology, and exploring cost effective opportunities for satisfying military requirements for increased survivability and remote sensing capability. The funding request is based on awarded, ongoing contracts, contractor proposals, or contractor estimates. The confidence in the cost estimates ranges from Comprehensive (Level I) to Budget (Level III) depending on the maturity of the individual effort. Last comprehensive review of cost estimate completed in July 1986.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: In FY 1989, DMSP will integrate the new microwave water vapor sounder on satellite S-13, and the first Block 5D-3 satellite (S-15) will complete subsystem level testing and start system level integration and testing with all sensors. After completion of preliminary studies, development of the prototype light detection and ranging (LIDAR) sounder for determination of cloud top heights and aerosol content will begin. This effort is slated to fly under the Space Test Program (PE 63402F) and is currently ranked as the highest priority Air Force experiment. This is the first phase in a three phased program that will ultimately lead to the ability to measure global winds from space in the late 1990's. Command and control system upgrades will continue and the Fairchild Satellite Operations Center will reach initial operational capability. Upgrades to the remaining seven older 1960's era fixed site Mark IIA and III tactical data receipt and processing terminals will begin to bring them up to the standards of the newer mobile Mark IVs. In FY 1989, DMSP will continue its second multi-year procurement and procure two Block 5D-3 spacecraft (S-16 and S-17) with expanded advanced material buy for economic order quantities, funded to termination liability, for the S18-20 spacecraft which will follow in FY 1991. In FY 1990, DMSP will award two competitive advanced development contracts for Block 6, based upon the result of the FY 1988-1989 concept studies.

(5) (U) Program to Completion: This is a continuing program. The program will continue development of Titan II-compatible spacecraft allowing a transition to Titan II in FY 1990. Upgrades to the spacecraft and sensors will continue to take advantage of developing technology, allowing the system to better meet the validated requirements of the special strategic missions and the Joint Chiefs of Staff. Development of the LIDAR sensor, multi-year procurement of replenishment satellites to meet mission requirements, and competitive design and development of DMSP Block 6 will continue.

C. (U) Major Milestones:

	Milestones	Dates
(1)	(U) Launch of First Block 5D-2 Satellite	20 December 1982
(2)	(U) Launch of Second Block 5D-2 Satellite	17 November 1983
(3)	(U) Award of Block 5D-2 Multi-year Procurement Contract (Spacecraft)	8 September 1983
(4)	(U) Development of the Block 5D-3 Titan II Qualified Spacecraft (S-15)	FY 1986-90
(5)	(U) Award of Block 5D-3 Multi-year Procurement Contracts	FY 1988-89
(6)	(U) Titan II Launch Capability for DMSP	FY 1990
(7)	(U) Shared Facility at Thule Operational	FY 1988
(8)	(U) Close Existing Loring AFB Command Facility	FY 1988
(9)	(U) Command/Control Facility at Fairchild AFB Operational	FY 1989
(10)	(U) Block 6 Concept Studies	FY 1988-89
(11)	(U) Block 6 Advanced Development/Full Scale Engineering Development	FY 1990-94
(12)	(U) First Block 6 Delivery (S-21)	FY 1998

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 35171F Title: Space Shuttle Operations
DOD Mission Area: 410 - Space Launch & Orbital Support Budget Activity: 6 - Defense-Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		66,711	103,837	86,554	156,070	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Department of Defense places heavy reliance on its space assets to accomplish its strategic, and tactical airlift missions. Requirements include such capabilities as communications, navigation, weather, early warning, and surveillance. An access to space is required for these space assets to perform their respective missions. The Space Shuttle Operations program provides the Space Transportation System resources needed to transport Air Force space payloads to their mission orbits. Main program objectives are to provide consolidated management, programming, and execution of operational Air Force Space Shuttle, Inertial Upper Stage (IUS), and Payload Assist Module-Delta Class II (PAM-D II) upper stage programs and the Vandenberg Shuttle Launch and Landing Site (VLS). This includes activities that are common both to research and development programs and to operational satellite programs, as well as payload integration and flight operations planning. The program also funds the development and acquisition of upper stages to support launches in the early 1990s. DOD use of the Space Shuttle is paid for in the form of an Orbiter Flight Charge reimbursement made to NASA one year prior to the scheduled launch date. Work performed in support of research and development satellite programs is funded in the RDT&E appropriation. While work performed in support of operational satellite programs is funded in the Operations and Maintenance appropriation.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	75,432	175,867	226,621	N/A	Continuing	N/A
Missile Procurement	240,699	59,062	109,286	N/A	Continuing	N/A

EXPLANATION: (U) The FY 1986 decrease is attributable to pricing and support adjustments. The FY 1987 decrease is attributable to Congressional redcutions. The FY 1988 decrease reflects transition of the Vandenberg Shuttle Launch Site to "minimum facility caretaker" status, termination of the NASA Shuttle/Centaur program, and a revised Orbiter Flight Charge payment schedule due to the Challenger accident. Also, procurement of PAM-D II upper stages for Global Positioning System (GPS) satellites 29-48 has been deleted. Upper stages for these GPS satellites are planned to be procured as part of the follow-on Delta II launch vehicle buy.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Missile Procurement:						
Funds	223,258	37,769	108,051	83,887	Continuing	N/A
Quantities						
Inertial Upper Stage	3	0	0	0		
Payload Assist Module-Delta Class II	9	8	4	0		
Other Procurement:						
Funds	4,947	4,552	0	0	Continuing	N/A
Quantities	Not Applicable					

5. (U) RELATED ACTIVITIES: The research and development satellite program supported is the Space Test Program (PE 63402F). The operational satellite programs supported are the Defense Satellite Communications System (PE 33110F) the Defense Support Program (12431F), and Navstar Global Positioning System (PE 35165F). The individual Air Force payload programs will provide resources for nonrecurring integration and program-unique launch hardware and/or services. The resources for support to other Department of Defense programs are included in the appropriate Special Activity and Department of the Navy Program Elements.

6. (U) WORK PERFORMED BY: The responsible Air Force agency is the Air Force Systems Command's Space Division, Los Angeles, CA. Systems engineering is provided by the Aerospace Corporation, El Segundo, CA. The IUS and spacecraft integration contractor is the Boeing Aerospace Company, Seattle, WA. The Payload Assist Module (PAM-D) II contractor is the McDonnell-Douglas Astronautics Company, Huntington Beach, CA. The Mission Integration Support Contractor is Martin Marietta Corporation, Denver, CO. The Vandenberg Shuttle Processing Contractor (SPC) is the Lockheed Space Operations Company, Titusville, FL. The National Aeronautics and Space Administration is the Space Transportation System manager and operates the national Space Shuttle eastern launch site at Kennedy Space Center, FL, and the Mission Control Center at Johnson Space Center, TX.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

Program Element: 35171F — Title: Space Shuttle Operations
DOD Mission Area: 410 - Space Launch & Orbital Support — Budget Activity: 6 - Defense-Wide Mission Support

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989

(U) Project: 35171F - Space Shuttle Operations

A. (U) Program Description: This program provides the Shuttle operations resources that are common to the Department of the Air Force research and development and operational satellite programs. This support includes procurement of the Inertial Upper Stage (IUS) and Payload Assist Module-Delta Class II (PAM-D II) upper stages, their associated launch services, payment of Orbiter Flight Charge reimbursements to the National Aeronautics and Space Administration, provision of mission control operations, Manned Spaceflight Engineer (MSE) program, recurring payload integration, and preservation of the national Space Shuttle Launch and Landing Site (VLS) at Vandenberg AFB, CA. The procurement of upper stages for Defense Support Program (DSP) satellites 18-22 is included as well as the development of a 10,000 lb-class upper stage to support heavy payload programs in the 1990's.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: The FY 1986 program included payment of the NASA Orbiter Flight Charges and mixed integration costs to support missions to be flown in FY 1987. Because of the Challenger accident, no missions will be flown in FY 1987. The production of three additional IUS vehicles began under the second production contract. The Centaur G upper stage procurement to support the Milstar program was moved to the Titan IV program. Procurement of PAM-D II upper stages to support the Global Positioning System (GPS) program continued. The MSE program continued with payload specialist selection for DoD Shuttle missions and continued evaluation of military man in space. The first launch of a Shuttle from VLS was delayed due to the Challenger accident and the commitment of the Orbiter fleet to the East coast until Shuttle recovery is complete.

(2) (U) FY 1987 Program: The production of three additional IUS vehicles that began under the second production contract will continue. Procurement of PAM-D II upper stages to support the GPS program will continue. Development will start on the DSP upper stage. The MSE program will continue with payload specialist selection for DoD shuttle missions and continued evaluation of military man in space. The VLS will transition to "minimum facility caretaker" status. Concept studies will begin for a 10,000 lb-class upper stage.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The FY 1988 program will continue development of a upper stage for DSP satellites 18-22. Development will also start for a 10,000 lb-class upper stage for the 1990s. This upper stage will be capable of delivery up to 10,000 lbs of payload to geosynchronous orbit and make heavy spacecraft, like Milstar, capable of flying on the Shuttle for assured access to space. VLS will attain and continue in "minimum facility" caretaker status. FY 1988 funding will also sustain the MSE program Shuttle payload integration and mission/program support. Cost estimates are based upon prior experience for like efforts.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The FY 1989 program will resume payment of secondary payload Shuttle flight charges to NASA. Secondary payloads include experiments, small payloads, and tests performed in the Shuttle crew cabin. Development of the 10,000 lb-class upper stage will continue. VLS will remain in

"minimum facility caretaker" status. FY 1989 funding will also sustain the MSE program and provide for aerospace support equipment development, payload integration and Shuttle mission/program support. Cost estimates are based upon prior experience for like efforts.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones:

		Milestones	Dates
(1)	(U)	Inertial Upper Stage (IUS) Defense Systems Acquisition Review Council (DSARC-II)	March 1978
(2)	(U)	Long lead award, 1st IUS production contract	July 1980
(3)	(U)	First Shuttle Flight	April 1981
(4)	(U)	First DoD use of the Shuttle	June 198[illegible]
(5)	(U)	First Titan/IUS flight	Octobe[illegible]
(6)	(U)	Shuttle Initial Operational Capability (IOC) at Kennedy*	Novem[illegible]82
(7)	(U)	First Shuttle/IUS flight**	April [illegible]3
(8)	(U)	Shuttle Processing Contract Award	October 1983
(9)	(U)	PAM-D II block buy contract	December 1983
(10)	(U)	First DoD operational Shuttle flight	January 1985
(11)	(U)	Vandenberg Launch and Landing Site IOC	October 1985
(12)	(U)	Shuttle (Challenger) accident	January 1986
(13)	(U)	Caretaker Status Decision for Vandenberg Launch Site	July 1986
(14)	(U)	Shuttle Flight Resumption (Planned)	February 1988

* NASA Milestone
** Civil payload

(U) Explanation of Milestone Changes: Not applicable.

9. (U) COOPERATIVE AGREEMENTS: Not Applicable.

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 71112F
DOD Mission Area: 475 - Central Supply and Maintenance

Title: Inventory Control Point Operations Embedded Computer Support Improvement Program (ESIP)
Budget Activity: 6 - Defense-wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT	2,737	4,628	4,346	4,480	Continuing	N/A
3090 Embedded Computer Support Improvement Program	2,737	4,628	4,346	4,480	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: The Embedded Computer Resources (ECR) Support Improvement Program (ESIP) is a program to improve the support of embedded computer systems (ECS) in terms of mission responsiveness and productivity. This will be accomplished through exploiting current technology, applied management techniques and establishment of an information distribution network. This program encompasses four areas: (1) Automation and Standardization of ECS Support Processes, (2) Advanced Extendable Integration Support Facility (AEISF), (3) ECS Readiness Support, (4) ECS Support Networks.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	2,924	4,788	4,438	N/A	Continuing	N/A

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: While other programs improve Air Force Logistics Command's embedded computer/software support capabilities for specific weapons systems, this program is the only Air Force effort directed at improving those capabilities which provide common support for multiple weapons systems.

6. (U) WORK PERFORMED BY: Competitive contracts are managed by Air Force Systems Command's Aeronautical Systems Division, Wright-Patterson AFB, OH. The contractors are SYSTRAN, Dayton, OH; TRW, Dayton, OH; and Georgia Tech Research Institute, Atlanta, GA.

Program Element: 71112F
DOD Mission Area: 475 - Central Supply and Maintenance

Title: Inventory Control Point Operations Embedded Computer Support Improvement Program (ESIP)
Budget Activity: 6 - Defense-wide Mission Support

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3090, Embedded Computer Resources Support Improvement Program (ESIP)

A. (U) Project Description: See paragraph 2.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Completed requirements and concepts definition for the next-generation Advanced Extendable Integration Support Facility (AEISF) that will be employed to rapidly reprogram Mission Critical Computar Resources (MCCR) embedded in USAF weapon systems. Developed and demonstrated (in an F-16 Integration Support Facility (ISF) testbed environment) a prototype, data-driven, replicated shared-memory network for real-time computer systems. Completed construction of a baseline Advanced Performance Monitor and Control (APMAC) unit for pre-Very High Speed Integrated Circuit (VHSIC) MCCR. Demonstrated prototype Electronic Countermeasure (ECM) signal generator to be duplicated for Air Force Logistics Command (AFLC) use.

(2) (U) FY 1987 Program: Continue critical technology developments for insertion into prototype AEISF. Transition technologies (APMAC, ECM generator and data-driven network) directly to AFLC F-16 and A-10 ISFs. Commence system level design/development of AEISF. Perform test planning and instrumented testbed integration to measure representative airborne fire control radar internal signal/data flow responses to Electronic Warfare (EW) environments. Survey the reprogrammability of current and planned Communication-Navigation-Integration (CNI) systems and plan a detailed measurements program of signal/data flow responses to EW environments.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: AEISF system critical design will be completed with critical technologies independently demonstrated. Perform detailed measurements of fire control radar internal signal/data flow responses to EW environments. Execute CNI measurements program planned in FY 1987.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Plans to enhance APMAC and AEISF/APMAC integration with VHSIC MCCR will occur in FY 1989. Further testing will be done on the Radar Electronic-Counter-Counter-Measures (ECCM) Analysis Program (REAP) radar in both roof house and flight teet environments. CNI study results will be incorporated into a final report; however, the CNI data base will continue to be updated.

(5) (U) Program to Completion: This is a continuing program. Radar and CNI measurements for the rapid reprogramming data-base will continue through FY 1990. The AEISF/APMAC, radar measurements and CNI measurements programs will be integrated into the Advanced Avionics Integration Support Facility (AAISF) Demonstration/ Validation (DEM/VAL) program that will start in FY 1990.

C. (U) Major Milestones:

Milestones				Dates
(1)	(U)	Baseline Advance Extendable Integration Support Facility (AEISF) technology demonstration	*(September 1986)	July 1986
(2)	(U)	AEISF and Electronic Countermeasures/Electronic Counter-Countermeasures (ECM/ECCM) studies complete	*(June 1986)	August 1986
(3)	(U)	Baseline Advance Performance Monitor and Control (APMAC) technology demonstration	*(September 1986)	October 1986
(4)	(U)	Rapid Turnaround for Communication-Navigation-Integration contract award	*(September 1986)	October 1986
(5)	(U)	Radar ECCM Analysis Program (REAP) contract award	*(September 1986)	December 1986
(6)	(U)	ECM Generator demonstration	*(May 1986)	January 1987
(7)	(U)	Built-In Support Function (BISF) for Very High Speed Integrated Circuits (VHSIC) definition		January 1987
(8)	(U)	VHSIC/1750A APMAC development start		February 1987
(9)	(U)	AEISF System contract award	*(January 1987)	September 1987
(10)	(U)	Baseline Realtime Network to Ogden		December 1987
(11)	(U)	REAP Test Facility Support start		December 1987
(12)	(U)	REAP Radar Modification complete		March 1988
(13)	(U)	Modular Embedded Computer System (ECS) Software Study		July 1988
(14)	(U)	CNI ECM Test complete		December 1988
(15)	(U)	Radar roof house testing complete		March 1989
(16)	(U)	CNI Final Report complete		June 1989
(17)	(U)	REAP Flight Test start		September 1989
(18)	(U)	Integrated Electromagnetic System Simulator linked to AEISF baseline		December 1989
(19)	(U)	AEISF/APMAC VHSIC integrated technology demonstration		January 1990
(20)	(U)	REAP Flight Test Final Report complete		September 1990
(21)	(U)	Advanced Avionics Integration Support Facility (AAISF) demonstration/validation (DEM/VAL) contract award		December 1990

* Date presented in FY 1987 Descriptive Summary

Program Element: 71112F
DOD Mission Area: 475 - Central Supply and Maintenance

Title: Inventory Control Point Operations Embedded Computer Support Improvement Program (ESIP)
Budget Activity: 6 - Defense-wide Mission Support

(U) Explanation of Milestone Changes

(1) (U) Advanced Extendable Integration Support Facility (AEISF) demonstration advanced two months because pre-planned software de-bugging not required.
(2) (U) AEISF and Electronic Countermeasures/Electronic Counter-Countermeasures (ECM/ECCM) studies delayed two months because contractor needed additional documentation to complete.
(3) (U) Advance Performance Monitor and Control (APMAC) demonstration delayed one month because of unforeseen timing problems during software de-bugging.
(4) (U) Communication-Navigation-Integration (CNI) contract award delayed one month because of additional fact finding required prior to contract award.
(5) (U) Radar ECCM Analysis Program (REAP) contract award delayed three months because contractor questions necessitated a revaluation of planned test facilities.
(6) (U) ECM Generator demonstration delayed eight months because of slip in Navy procurement cycle (original test article being procured from Navy).
(9) (U) AEISF contract award delayed four months because studies (2) revealed additional investigation requirements.

8. (U) PROJECTS OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 72207F
DOD Mission Area: 475 - Central Supply and Maintenance
Title: Depot Maintenance
Budget Activity: 6 - Defense-wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		0	0	998	974	Continuing	N/A
3326	Precision Measurement & Calibration Equipment Development	0	0	998	974	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program develops, tests, and evaluates measurement standards and associated equipment for 130 Base Precision Measurement Equipment Laboratories which are strategically located around the world. These standards are used in the calibration of every weapon system in the AF inventory, and must provide accuracies which are traceable to the National Bureau of Standards. These accuracies are the foundation for the calibrations necessary to place aircraft, bombs, and missiles on target in times of need. An extremely adverse impact on weapons accuracy, quality, reliability, maintainability, and associated life cycle costs can be expected if measurement support is unavailable. Inherent in the technology of modern weapons systems is the requirement for research and development of the calibration standards to support them. The equipment necessary to accomplish this task is not available. This FY 1988 new start will provide the means to accomplish this vital task in a timely manner.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	0	487	6,734	N/A	Continuing	N/A

EXPLANATION: (U) Congressional denial of funds in FY 1987, FY 1988 restart.

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable

5. (U) RELATED ACTIVITIES: Research and development of metrology calibration standards is accomplished primarily by the National Bureau of Standards (NBS) in cooperation/collaboration with the Engineering Working Groups of the Calibration Coordination Group of the Joint Technical Coordinating Group for Metrology and Calibration (JTCG-METCAL). Th JTCG-METCAL is a Tri-Service group under charter of the Joint Logistics Commanders. The specific work to be done is for tasks defined by nonduplicative work packages that are closely coordinated with Army and Navy METCAL programs. This approach where only one service manages and funds specific work was mandated by a Joint Logistics Commanders' Agreement, 8 January 1985.

Program Element: 72207F
DOD Mission Area: 475 - Central Supply and Maintenance

Title: Depot Maintenance
Budget Activity: 6 - Defense-wide Mission Support

6. (U) WORK PERFORMED BY: Work performed is primarily by NBS (about 60%), private industry (about 25%), universities/nonprofit institutions (about 10%), and less than 5% in-house at the Air Force Primary Standards Laboratory.

7. (U) SINGLE PROJECT LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 3326, Precision Measurement and Calibration Equipment Development

A. (U) Project Description: The objective of this project is to develop, test, and evaluate precision measurement standards and associated equipment used in the measurement and calibration of advanced weapons systems and support equipment. There is a need to develop measurement and calibration capabilities for high technology areas such as lasers, microwave, millimeter wave, electro-optical, and automatic test equipment in order to support the accuracy, reliability, and quality of the advanced systems which use these technologies.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Not applicable

(2) (U) FY 1987 Program: Not applicable

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: Work will begin on the development of millimeter wave standards for the low observable program, and the development of electro-optical standards to support laser-guided weapons such as Low Altitude Navigation and Targeting Infrared System for Night and infrared missiles such as the imaging Infrared Maverick and the improved SIDEWINDER. This program will also support the development of improved, ruggedized field temperature sensors required to monitor advanced jet engine temperatures, and initiate efforts to establish more accurate direct current voltage measurements. Further, development of less environmentally sensitive, miniaturized test equipment for use in transportable Automated Test Equipment capable of in-place and on-site calibration will begin. Cost estimates are based on National Bureau of Standards (NBS) and AF engineering analysis of the specific tasks to be performed and projected man-years for completion. Firm NBS man-year cost data is used in computing the total program estimate. Cost category IV, Planning, applies. The last comprehensive cost estimate review was conducted in September 1986.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: Items to be delivered include working models, prototypes, and developed standards for laser, infrared, microwave/millimeter wave, electronic, and physical/mechanical measurement areas. Weapon systems and programs supported include: F-15 Tactical Electronic Warfare System, Target and Background Information System, Ultra Reliable Radar, Agile Radar, Radar Cross Section Measurements, Advanced Tactical Fighter, High Energy Lasers, Hypervelocity Missile and a number of laser guided weapons. In addition, the metrology (measurement) generic technical base will be improved with new standards in areas of fiberoptics, carbon

dioxide laser radar parameters, resistance, voltage, pressure, and temperature in support of guidance, airspeed, altitude, airflow, and jet engine temperature measurement requirements. Cost estimates are based on National Bureau of Standards (NBS) and AF engineering analysis of the specific tasks to be performed and projected man-years for completion. Firm NBS man-year cost data is used in computing the total program estimate. Cost category IV, Planning, applies. The last comprehensive cost estimate review was conducted in September 1986.

(5) (U) Program to Completion: This is a continuing program. Successive year funding will complete initial development of millimeter wave standards, electro-optical standards, and improved temperature sensors by FY 1991. Development of miniaturized test equipment is anticipated to run to FY 1992. This program is updated and refined through the efforts of the Joint Logistics Commanders' Joint Technical Coordinating Group for Metrology and Calibration.

C. (U) Major Milestones: Not applicable

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not applicable

9. (U) COOPERATIVE AGREEMENTS: Not applicable

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 78011F — Title: Industrial Preparedness
DOD Mission Area: 490 - Production Base Support — Budget Activity: 6 - Defense-Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		58,872	60,459	94,967	94,973	Continuing	N/A
2865	Manufacturing Technology	58,872	60,459	94,967	94,973	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: Manufacturing Technology (MANTECH) is part of a larger Air Force Industrial Base Program that includes many activities that impact overall industrial preparedness and productivity; key elements in force readiness, modernization and sustainability. MANTECH is the only concentrated R&D manufacturing effort in the Air Force. Its purpose is to develop the necessary manufacturing processes that determine what products can be produced and at what cost. History demonstrates that manufacturing process technology often precedes advances in product technology and performance. MANTECH helps transition state-of-the-art R&D product designs into producible and cost-efficient weapon systems and components. MANTECH efforts are critical in maintaining a strong defense industrial base and in solving manufacturing technology problems that hinder preparedness and productivity goals. MANTECH includes a Manufacturing Science thrust that is part of Science and Technology.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	62,895	83,573	68,833	N/A	Continuing	N/A
Aircraft Procurement	51,900	38,400	55,500	N/A	Continuing	N/A
Missile Procurement	20,626	14,458	14,051	N/A	Continuing	N/A
Other Procurement	2,497	21,271	2,231	N/A	Continuing	N/A

(U) FY 1986 RDT&E and Procurement lines were reduced due to Gramm-Rudman and inflation readjustments. FY 1987 RDT&E line was reduced $20 million by Congress due to overall "fiscal constraints" and to account for profit and fuel readjustments. The FY 1987 Other Procurement and RDT&E lines were also reduced as a result of Congressional "fiscal constraints." The FY 1987 Missile and Aircraft lines were increased as a result of a transfer of funds from the Defense Environmental Restoration Account. The FY 1988 RDT&E line is being increased to execute a plan approved by the President to help revitalize the United States machine tool industry. It provides support for a National Center for Manufacturing Sciences. The increase is also a result of a recommendation by the National Research Council that called for increased generic producibility and manufacturing technology development by DOD to complement investments in pure product R&D. This effort is part of a DOD strategy to encourage American industries to invest in manufacturing technology. The FY 1988 Aircraft Procurement line was reduced by the OSD comptroller based on obligation projections.

Program Element: 78011F   Title: Industrial Preparedness
DOD Mission Area: 490 - Production Base Support   Budget Activity: 6 - Defense-Wide Mission Support

The FY 1988 Other Procurement Account is increased as a result of an Authorization Act for FY 1987 requirement directing Military Departments to reimburse the appropriation that supports the Defense Industrial Plant Equipment Center. Partial funds were transferred to the Air Force from DLA to fund this activity that had been previously a DLA function.

4. (U) OTHER APPROPRIATION FUNDS: ($ in thousands)

	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
Aircraft Procurement: Funds	57,656	41,691	40,000	36,500	Continuing	N/A
Missile Procurement: Funds	18,234	17,045	13,517	15,998	Continuing	N/A
Other Procurement: Funds	2,259	4,114	5,107	5,198	Continuing	N/A

5. (U) RELATED ACTIVITIES: Both the Army and Navy have Industrial Preparedness and Manufacturing Technology (MANTECH) programs (PE #78011A and PE #78011N) that are coordinated with this program. Other government agencies such as NASA and the National Bureau of Standards also pursue MANTECH related efforts. All MANTECH programs are fully coordinated through the DOD MANTECH Advisory Group which includes government and industry participants. Technology base programs help provide the research and development that MANTECH then scales-up, integrates, validates, demonstrates, and establishes as new or improved production capability. MANTECH provides production technologies for implementation by the Technology Modernization Program that can contractually encourage aggressive capitalization and modernization by DOD weapon system and component producers. MANTECH supports generic manufacturing technology that impacts nearly all future hardware production and maintenance activities.

6. (U) WORK PERFORMED BY: The program is executed by Air Force Systems Command, Andrews AFB, MD, and Air Force Logistics Command, Wright-Patterson AFB, OH, for implementation primarily by private industry at contractor and Air Force Air Logistics Center locations. Agencies participating include the Wright Aeronautical Laboratories, Wright-Patterson AFB, OH, Air Force Product Divisions, and the Air Logistics Centers. Technical effort is accomplished almost exclusively by competitive contract and nearly all major aerospace prime and sub-tier contractors participate. The top six contractors are General Electric Company, Evendale, OH; United Technologies Corporation, West Palm Beach, FL; Martin Marietta Corporation, Orlando, FL; Westinghouse Electric Company, Baltimore, MD; Boeing Aircraft Corporation, Seattle, WA; and General Dynamics Corporation, Fort Worth, TX.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable

Program Element: 78011F — Title: Industrial Preparedness

DOD Mission Area: 490 - Production Base Support — Budget Activity: 6 - Defense-Wide Mission Support

8. (U) SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:

(U) Project: 2865, Manufacturing Technology

A. (U) Project Description: The Manufacturing Technology (MANTECH) program is a broad based production improvement program that provides new/innovative manufacturing technologies that result in more economical, timely, and reliable production and design of Air Force systems. Projects result in factory floor and design room application of productivity enhancing improvements. MANTECH fosters the use and development of enhanced manufacturing equipment, processes and techniques and continuously advances the state-of-the-art in manufacturing by bridging the gap from R&D to production. MANTECH stimulates industrial innovation by the government sharing the cost and risk involved in advancing and applying improved production methods, equipment and processes. Current thrusts include: (1) Airframe Production and Productivity, (2) Low Observable Configurations, (3) Propulsion, (4) Electronics, (5) Maintenance and Repair, (6) Computer Integrated Manufacturing, (7) Strategic Missile and Launch System Productivity, (8) Space Syste Manufacturing Productivity, (9) Tactical Systems, and (10) Manufacturing Science.

B. (U) Program Accomplishments and Future Efforts:

(1) (U) FY 1986 Accomplishments: Implemented a Retirement for Cause inspection system at San Antonio Air Logistics Center (ALC). The system will reduce logistics costs by avoiding the scrapping of "good" parts, extending the life of components, and by the avoidance of spare purchases. Estimated $450 million savings will be realized over the life of the F100 engine. Implemented an automated welding and grinding cell at Oklahoma City ALC. Established low cost, high reliability manufacturing processes for intercontinental ballistic missile engine manufacture. Continued work on establishing cost effective manufacturing capability for production of large aircraft wing and fuselage components. Established repair techniques for single crystal turbine blades. Established cost effective manufacturi techniques for production of radomes having low observable characteristics. Demonstrated Advanced Machining System integrate computerized work scheduling, control of manufacturing processes and automated machining. Same project is continuing work to extend technologies involved to subcontractor machine shops.

(2) (U) FY 1987 Program: In the Airframe and Productivity Thrust, will establish advanced methods and more economical processes to fabricate, shape and assemble required high quality thermoplastic composite and metallic aircraft and missile components. In the Propulsion Thrust, will advance the development of low cost manufacturing processes used to produce turbine engines. Includes work on casting methods needed to accompany advances in high density, high strength superalloys used for engine turbines and airfoils. In the Electronics Thrust, efforts will continue to be established that will result in a reliable screening process for complex Very High Speed Integrated Circuit chips. Advances will be explored in control processing to achieve higher yields and larger volume production ability of Gallium Arsenide wafers. In the Logistics Maintenance and Repair Thrust, advanced commercial techniques developed with government coordination will be transferred and demonstrated at an Air Logistics Center (ALC). An engine repair center will be developed which will use the latest flexible machining technologies. A robotically controlled paint stripping system will be developed for ALC use. Computer geometric modeling techniques will be applied to the automated inspection of turbine blades. In the Computer Integrated Manufacturing Thrust, software/hardware integration

will be developed to support a Composites Fabrication Center and Airframe Assembly Center. Computer-oriented information and benefits tracking software will be developed for use and support of Manufacturing Technology (MANTECH) projects. In the Space Systems Thrust, radiation hardening manufacturing technology will be completed resulting in superior chip design with improved survivability characteristics. In the Tactical Thrust, efforts will proceed to demonstrate advanced processing, packaging, and testing of millimeter-wave diodes, essential elements in avionics systems. In the Manufacturing Science Thrust, work will be initiated that will result in computer simulation ability directed at autoclave curing of composite materials. Tool and die design computer aided manufacturing will be developed. Work to establish an Institute for Artificial Intelligence in Manufacturing will continue using Cooperative Agreements among participating industries, university and government agencies.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: The FY 1988 Manufacturing Technology program represents the minimum effort needed to meet the manufacturing research needs of the Air Force. Concurrent manufacturing process technology development is essential to corresponding product research and development that will occur during this period of time. Without such development, design technologies out-strip product capabilities. The result is often adverse media stories about quality and inefficiency at many of DOD's leading production locations. In the Air Frame Production and Productivity Thrust, work will continue on economical production methods of aircraft composite wing and fuselage structures. Evaluations will be conducted to determine manufacturing process impact on advanced composite materials being used on Air Force systems. In the Low-Observable Thrust, effort will be devoted to scale-up the manufacturing of expensive and time-consuming radar absorbing materials. In the Propulsion Thrust, improved methods will be established to produce engines using promising new carbon-carbon and titanium aluminide materials. Nozzles, vanes and integrally bladed rotors will be the focus for using these new materials. This thrust will demonstrate improved casting techniques that can produce defect-free, titanium ingots. In the Electronics Thrust, work will continue to improve fabrication and inspection of very high speed integrated circuit printed wiring board substrate fabrication. This work is evaluating risks involved with various manufacturing techniques associated with hermetic chip carriers and advanced packaging of electronic components. This effort will also continue high volume manufacturing research of gallium arsenide devices. In the Logistics Thrust, work will continue on composite and engine repair centers. Software will be developed to allow geometric modeling of turbine blades and disks to establish a repair data base. Means will be established to obtain consistent, reliable transducers for nondestructive inspection. Air Logistics Center opportunities for robotic and laser applications will be explored. In the Computer Integrated Manufacturing Thrust, manufacturing cost/designs guides will be developed. A digital data exchange standard will be developed to reduce the number and complexity of engineering drawings. Technology and support software will be developed to complement earlier flexible assembly of components projects. Sensing and control technologies will be integrated to advance intelligent task automation. Advanced machining concepts for subcontractors will be continued. In the Strategic Missile Thrust, an automated system will be developed to produce chaff. In the Space Systems Thrust, work will continue on radiation hardened chip and mercury cadmium telluride arrays. Reproducible production methods for metal matrix composites will be developed. In the Manufacturing Science Thrust, software will be developed for an artificial intelligence based machining system. Full automation fabrication of optical filters will be investigated. Establishment of an Institute for Artificial Intelligence in Manufacturing will continue using cooperative agreements between participating industries, universities and government agencies. The program also includes $5.0 million per year for three years, with matching funds to come from private industry, to help execute a Domestic Action Plan approved

by the President to revitalize the United States tool industry. The funds will support a National Center for Manufacturing Science that will conduct advanced manufacturing technology research with the long-range goal of helping the American tool industry regain its past market strength.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The Manufacturing Technology (MANTECH) Program for FY 1989 continues to target generic manufacturing technology and process voids that impact the cost-effective production of Air Force weapon systems. A majority of FY 1988 projects will be continued and/or completed as part of the FY 1989 program. Eight of the ten thrust areas presented in the FY 1988 section will also be pursued in FY 1989. The FY 1989 program includes over 30 manufacturing R&D endeavors. For example, the large aircraft composite program will continue to pursue economical manufacturing methods enabling the application of greater composite use on future bomber and transport aircraft. Establishing automated fabrication of very large wing and fuselage structures can reduce current fabrication costs by 50% and reduce aircraft weight by 20% enabling greater aircraft performance. Thermoplastic forming manufacturing R&D will continue promising dramatic "toughness" improvements that will lead to lower supportability costs. In the Propulsion Thrust, generic manufacturing research with advanced materials will continue. This thrust is reviewing cost and design-critical fan and duct manufacturing processes that could provide 60 pound weight reductions and 30% manufacturing cost reductions to programs using the new processes. Maybe more important is the thrust to weight ratio gained by user engines. The program will analyze the use of new blade alloys and automation of production of engine cases, frames, ducts, liners and nozzles. This thrust includes continuation of rapid solidification process manufacturing technology development that is considered to be one of the major alloy and strength breakthroughs in engine technology in recent years. Rapid solidification involves taking metal alloys from liquid to solid in one millionth of a second for improved strength, corrosion-resistance, and lower operating costs. In the Electronic Thrust work will be completed on improving printed circuit board economic producibility. The thrust focus is to develop boards that have minimal solder joint failures at leadless chip carrier attachment points. Improved yields will result. An electronics manufacturing cost design guide will be completed during FY 1989. The Maintenance and Repair Thrust focuses on improving capabilities in flaw detection and nondestructive evaluation procedures and equipment. Work to establish an In-Service Inspection System will allow composite structures to be evaluated for wear without expensive component removal. Development of a model Composite Repair Center will provide milestone advances in automated techniques that can result in a 40% improvement over existing manual operations that are also prone to damaging expensive engine hardware. Engine blade savings alone could save future repair costs of $2-5 million annually. Continued work on a Flexible Repair Center will lead to reduced engine case repair time from as much as 120 days to 72 days and eliminate 3 to 5 repair operations allowing a fourfold increase in machining productivity. Logistics Product Support development will lead to greater computer aided design at repair centers and result in fewer errors in interpretation of paper engineering drawings and quicker repairs. These improvements translate into reduced spare part lead times (75% reduction is the goal) and reduced spare part inventories (60% reduction is the goal). When fully implemented the cost avoidance expected will be dramatic and in the billion dollar range. In the Computer Integrated Manufacturing (CIM) Thrust, demonstration work will continue in an effort to fully take advantage of state-of-the-art, more cost-effective CIM technology. The thrust demonstrates the payoffs possible at government contractors when the latest CIM technology is used. Cutting production lead times by 50%, eliminating 50% of non-touch labor, reducing touch labor by 25%, reducing raw material and in-process inventories by 50%, and reducing floor space requirements by as much as 30% are reachable goals being pursued in this thrust. Continued development of an Advanced

Program Element: 78011F | Title: Industrial Preparedness
DOD Mission Area: 490 - Production Base Support | Budget Activity: 6 - Defense-Wide Mission Support

Machining System will showcase computer integration for advanced planning, scheduling, factory control, and metal removal. The Machining Vendor initiative tailors the latest technology in metal cutting, cutting tools, machining data, machining systems, and management information to the needs of small subcontractors. In the Strategic Missile and Launch Systems Thrust generic manufacturing methods advancements for space and satellite electronics will continue. The focus will be on producibility and increasing yields of new electronic systems using focal plane arrays, radiation hardened chips, peripheral circuits for memories, and metal matrix composite technologies. The radiation hardened chip set work will demonstrate improved manufacturing methods on bulk silicon circuits that are essential to producing affordable future missile and space systems. Lightweight metal matrix structures will be needed to provide stiffness and strength in space hardware where weight directly impacts payload capabilities. In the Manufacturing Science Thrust the Air Force will continue to expand the science base for manufacturing process development. Projects include manufacturing development in the areas of smart assembly, computer-aided engineering for die design and manufacture, enhanced yield of mercury-cadmium/telluride detector arrays, computer-aided curing of structural composites, an intelligent machining work station, complex shaped thermoplastics and rugate filters. Cooperative efforts in manufacturing related to artificial intelligence technology and support for a private sector-operated National Center for Manufacturing Sciences will continue.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not Applicable

9. (U) COOPERATIVE AGREEMENTS: Not Applicable

FY 1988-89 Manufacturing Technology Program
TITLE: INDUSTRIAL PREPAREDNESS

Program Element: 78011F
DOD Mission Area: 490 - Production Base Support

Budget Activity: 6 Defense-Wide Mission Support

Procurement Appropriation Supported	Project I.D.	(Title) (End Items Supported)	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Complete	Total Est Cost
AIRCRAFT PROCUREMENT, AIR FORCE								
A	0001	Large Aircraft Fuselage Manufacturing C-17, Advanced Technical Bomber (ATB), Future Large A/C	0	2000	1700	500	0	13557
A	0002	Large Aircraft Wing Manufacturing B-1B, C-17, ATB	2800	2400	106	0	0	8300
A	0004	Manufacturing Process Effects on Properties All A/C Systems	70	250	250	180	0	750
A	0005	Mfg. Methods for Thermoplastics Advanced Tactical Fighter (ATF), Future Systems	0	500	2500	3000	3500	9500
A	0234	Radome Manufacturing Process Application Classified	575	2000	1016	0	0	3591
A	0028	A/C Binder Application Manufacturing Classified Applications	500	500	100	0	0	1100
A	0008	Manufacturing Technology for Advanced Propulsion Materials Advanced Fighter Engine, Future Systems	6482	16948	10019	4956	0	49547
A	0011	Solid State Microwave System ATF Radar, Satellites	2985	5167	4683	3240	0	16175

Program Element: 78011F
DOD Mission Area: 490 - Production Base Support

Budget Activity: 6 Defense-Wide Mission Support

Procurement Appropriation Supported / Project (Title) / I.D. (End Items Supported)			FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Complete	Total Est Cost
AIRCRAFT PROCUREMENT, AIR FORCE								
A	0092	Hermetic Chip Carrier Compatible Printed Wiring Board All Systems	0	800	1000	250	0	5270
A	0021	Machining Vendor Initiative F-16, Advanced Tactical Fighter (ATF), B-1	2706	3000	3072	0	0	8778
A	0227	Machining Vendor Initiative (Innov. Mach) F-16, ATF, B-1	521	500	79	0	0	1100
A	0022	Integrated Composite Center F-16, F-15, F-18, AV-8B, ATF	0	1400	2150	1100	0	8000
A	0023	Integrated Data Base Management All Systems	2600	3300	500	0	0	8200
A	0024	Intelligent Task Automation Electronic Assemblies	0	900	500	0	0	1400
A	0181	Automated Airframe Assembly ATF, Future Systems	0	500	3500	6000	15000	25000
A	0252	Improved Quality Titanium Ingot Advanced Engines	0	0	1000	2000	3000	6000
A	0251	Manufacturing Technology for Superplastic Formed Aluminum Advanced Aircraft	0	0	2000	2000	4000	8000
A	0250	Vendor/Subcontractor Communication Technology Advanced Systems	0	0	4000	5500	8300	17800

Program Element: 78011F
DOD Mission Area: 490 - Production Base Support

Budget Activity: 6 Defense-Wide Mission Support

Procurement Appropriation Supported / Project (Title) / I.D. (End Items Supported)			FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Complete	Total Est Cost
AIRCRAFT PROCUREMENT, AIR FORCE								
A	0249	High Temperature Structures Manufacturing Advanced Aircraft	0	0	2000	2000	11000	15000
A	0248	Product Assurance and Quality Control	0	0	0	3000	12000	15000
A	0268	MT for Low Cost Tooling Concepts for Advanced Composites Production Advanced Aircraft	0	0	1000	2000	6000	9000
A	0269	MT for Producibility of Critical Components for Hypersonic Vehicle Propulsion System Advanced Systems	0	0	1000	3000	8000	12000
A	0270	MT for Suppliers of Improved Quality, High Performance Structural Castings Advanced Systems	0	0	1000	3000	3000	7000
Total Aircraft Procurement, Air Force, Related					40175	41726		

Program Element: 78011F
DOD Mission Area: 490 - Production Base Support

Budget Activity: 6 Defense-Wide Mission Support

Procurement Appropriation Supported Project (Title) I.D. (End Items Supported)			FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Complete	Total Est Cost
MISSILE PROCUREMENT, AIR FORCE								
A	0229	Chaff Coil Manufacturing Peacekeeper, Small Intercontinental Ballistic Missile	0	800	500	0	0	1300
A	0246	Manufacturing Methods for Space Structures Advanced Satellites	0	0	2000	3000	2500	7500
A	0247	Manufacturing Methods for Space Electronics Advanced Satellites	0	0	2000	2500	3000	7500
Total Missile Procurement, Air Force, Related					4500	5500		

	Project I.D. (End Items Supported)		Actual	Estimate	Estimate	Estimate	Complete	Cost
O&M AIR FORCE								
A	0013	Composite Repair Center Depot Maintenance of F-16, F-15, Advanced Tactical Fighter	100	2500	1800	1000	0	5400
A	0055	Advanced Transducer Producibility Depot Inspection Activities	0	225	265	0	0	1427
A	0015	Robotic Application/Paint Stripping F-16, F-4, F-111 Repair	379	1200	510	412	0	2501
A	0237	Robotic Application/Derivet Airframe Repair	438	1000	1300	403	0	3141
A	0238	Robotic Application/Parts Replication Airframe Repair	125	250	145	0	0	520
A	0239	Thermospray Thickness Gauge Engine Repair	118	715	115	0	0	948
A	0016	Geometric Modeling Engine Depot Maintenance	925	2000	1625	0	0	6050
A	0127	Oklahoma City Air Logistics Center Flexible Repair Depot Level Remanufacturing	1000	2100	2100	875	125	6200
A	0019	Logistics Product Support Depot Spares Acquisition	0	500	3000	3000	3500	10000
A	0187	Static and Accessory Repair Engine Depot Maintenance	0	2600	2000	1000	0	5600

Program Element: 78011F
DOD Mission Area: 490 - Production Base Support

Budget Activity: 6 Defense-Wide Mission Support

Procurement Appropriation Supported Project (Title) I.D. (End Items Supported)			FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Complete	Total Est Cost
O&M AIR FORCE								
A	0810	Robotics Applications	0	0	1240	3810	5000	9240
A	0014	Engine Blade Removal Engine Depot Maintenance	100	2500	900	500	0	4000
A	0188	Whole Field Inspection Engine Depot Maintenance	0	0	0	1000	7000	8000
A	0024	Laser Applications Depot Maintenance	0	0	2000	3000	4200	9200
A	0271	MT for Advanced Computer Integrated Mfg Concepts for ALC Depot Maintenance Depot Maintenance	0	0	2000	3000	6000	11000
Total O&M, Air Force, Related					19000	15000		

Program Element: 78011F
DOD Mission Area: 490 - Production Base Support

Budget Activity: 6 Defense-Wide Mission Support

Procurement Appropriation Supported	Project (Title)	I.D. (End Items Supported)	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Complete	Total Est Cost
GENERIC PROCUREMENT								
A	0025	Manufacturing Cost Design Guide All Systems	555	345	450	0	0	1700
A	0026	Manufacturing Technology Benefits Analysis All Systems	400	700	700	700	700	2500
A	0027	Manufacturing Technology Program Assessment All Systems	0	600	1000	1000	1000	3600
A	0010	Advanced Data & Signal Processing (Very High Speed Integrated Circuits) All Systems	9000	6000	4000	2853	0	21858
A	0245	Manufacturing Cost Design Guide (Electronics) All Systems	0	0	0	500	1500	2000
A	0272	MT for Low Cost, High Reliable Electronic Components Producibility	0	0	5134	7544	37322	50000
Total Generic Procurement, Air Force, Related					11284	12597		

Program Element: 78011F
DOD Mission Area: 490 - Production Base Support

Budget Activity: 6 Defense-Wide Mission Support

Procurement Appropriation Supported Project (Title) I.D. (End Items Supported)			FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Complete	Total Est Cost
R&D, AIR FORCE								
A	0041	Institute of Artificial Intelligence in Manufacturing Generic Applicability	0	570	1500	2000	6000	10070
A	0179	Flexible Assembly Subsystems Engine Generic Applicability	399	700	50	0	0	1800
A	0037	Flexible Assembly Subsystems Airframe Generic Applicability	402	700	50	0	0	1370
A	0029	Automated Airframe Assembly Generic Applicability	50	250	1350	1650	0	25000
A	0182	Intelligent Machinist Generic Applicability	100	1200	1500	1150	1050	5000
A	0191	Rugate Filters Generic Applicability	100	900	1000	800	500	3300
A	0183	Complex Shaped Thermoplastics Generic Applicability	155	1200	1350	1550	0	4655
A	0236	Artificial Intelligence Design and Manufacturing Methods Generic Applicability	250	281	280	0	0	811

Program Element: 78011F
DOD Mission Area: 490 - Production Base Support

Budget Activity: 6 Defense-Wide Mission Support

Procurement Appropriation Supported Project (Title) I.D. (End Items Supported)			FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Complete	Total Est Cost
R&D, AIR FORCE								
A	0273	Mfg Science for Improved Design/Mfg Support, Data Modeling & Exchange Using Advanced Computer Technologies Generic Application	0	0	5000	5000	5000	15000
		Total R&D, Air Force, Related			12080	12150		
DIRECTED PROGRAM, AIR FORCE								
A	0274	Machine Tool Industry Revitalization Generic Application	0	0	5000	5000	5000	15000
		Program Support	2800	2800	2928	3000	0	N/A
		Total Directed Program, Air Force, Related			7928	8000		
		Grand Total Program Element 78011F			94967	94973		

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 78026F
DOD Mission Area: 490 - Production Base Support

Title: Productivity, Reliability, Availability Maintainability (PRAM)
Budget Activity: 6 - Defense-Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		13,102	14,264	19,560	20,413	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: In early 1985, the Air Force implemented an action plan called Reliability and Maintainability (R&M) 2000. A key element of this multifaceted effort is to consolidate various programmatic Air Force R&M initiatives into a centrally managed effort. PRAM is one of these initiatives. PRAM was established by the Chief of Staff in 1975 to meet the Air Force's need to reduce the rising cost of ownership and to improve productivity, reliability, availability and maintainability of operational systems. It is the only Air Force RDT&E program that can rapidly respond to fielded weapon system R&M problems and then get the fixes to the field before these problems become operationally debilitating. To this end, PRAM has continued to respond forcefully through judicious and timely investments in system projects which have led to significant increases in combat capability and lower life cycle costs. Since its inception, PRAM has initiated over 800 projects which have provided the Air Force with an estimated $16 billion in operations and support (O&S) cost avoidance savings. This equates to an approximate $30 NET return for every dollar invested. Unequivocally, PRAM is an Air Force success story.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

	FY 1986	FY 1987	FY 1988	FY 1989	Additional to Completion	Total Estimated Cost
RDT&E	13,999	31,405	39,198	N/A	Continuing	N/A

EXPLANATION: (U) The FY 1987 reduction is attributable to Congressional action. The reduction in FY 1988 funding is a reflection of an overall lower growth in the proposed Air Force budget request.

4. (U) OTHER APPROPRIATION FUNDS: Not applicable.

5. (U) RELATED ACTIVITIES: PRAM plays a complementary role with the Aircraft Engine Component Improvement Program (CIP) in PE 64268F. The CIP is concerned with supportability performance factors and reliability growth in specific operational engines. PRAM's role deals with those efforts applicable to improving reliability or lowering engine life cycle costs. To ensure their complementary operation, PRAM propulsion projects are closely coordinated with the Air Force Propulsion Lab and the Aeronautical Systems Division's Propulsion Program Office. A dialogue has also been established with the Army and Navy through which program activities and accomplishments are exchanged.

6. (U) **WORK PERFORMED BY:** The PRAM program office is located at Wright-Patterson AFB, OH. Satellite PRAM offices are located at each of the five Air Force Air Logistics Centers and the Aerospace Guidance and Metrology Center in Newark, OH. The Air Force Flight Dynamics, Avionics, Materials and Propulsion Laboratories, as well as the Air Force Flight Test Center, Aeronautical Systems Division, and the Space Division participate in PRAM projects. The largest PRAM contractors are: McDonnell Douglas Corp., St Louis, MO; Turbomach, San Diego, CA; Sperry Corp., Albuquerque, NM; and General Electric Co., Wilmington, MA.

7. (U) **PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:** Not Applicable.

8. (U) **SINGLE PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989:**

(U) **Project: 78026F, PRAM**

A. (U) **Project Description:** The PRAM program continues to respond to the requirements to increase the combat capability of fielded weapon systems while reducing the rising cost of ownership. This will be accomplished by focusing management attention and funds in a concentrated effort to improve reliability and maintainability (R&M) and to reduce operations and support costs. The program objectives are pursued through investments in projects that: (1) improve the R&M of fielded weapon systems through modifications and parts substitution; (2) improve the R&M of maintenance and logistics support organizations at all levels through improved procedures and documentation; and (3) exploit lower life cycle cost alternatives in systems configurations through component commonality methods and techniques. Implementation of these projects leads to: improved combat capability in our fielded systems; increased survivability of the combat support structure; more efficient use of mobility and manpower assets; and lower operations and support costs. PRAM projects are in the avionics, propulsion, missiles and space, depot maintenance, and other support areas.

B. (U) **Program Accomplishments and Future Efforts:**

(1) (U) **FY 1986 Accomplishments:** The FY 1986 program maintained the current level of participation of different Air Force agencies in the exploitation of reliability, maintainability and cost reduction opportunities. Senior military and civilian Air Force executives have reemphasized the need for this vital program. Accordingly, PRAM is applying maximum management attention to improve combat capability and to lower the cost of ownership of our in-service systems. Fifty-eight projects were selected for implementation in FY 1986. Some of the larger efforts are: Environmental Stress Screening for Electronic Components, B-52/C-130 Autopilot Amplifier Improvements, F-15 Wing Tip and Stabilator Honeycomb Replacement, C-141 Actuator Motor, and F-15 Nose Radome Improvement. Estimated cost avoidance savings from these efforts will be $390 million.

(2) (U) **FY 1987 Program:** The FY 1987 program reflects the Air Force's new emphasis on reliability and maintainability (R&M). Historically, the stated objective of PRAM was to reduce the cost of weapon system ownership. While this objective is still applicable, it is no longer the sole objective of the program. Henceforth, PRAM program objectives will be to: increase combat capability (e.g., increase system availability/sortie rates); increase the

survivability of the combat support structure; decrease mobility requirements (per unit); decrease manpower requirements (per unit of output); as well as decreased operations and support costs. Air Logistics Centers' and major commands' response to the R&M 2000 effort has resulted in a 50% increase in PRAM project proposals. For FY 1987, PRAM has committed all of its funding on 39 projects that will prototype, evaluate, and qualify needed R&M fixes to Air Force fielded systems. Examples of these R&M projects are; development of a more reliable Engine Inlet Ring for the A-10, qualifying improvements to the F-16 Invertor/Controller Automatic Test System, evaluating and qualifying a new High Reliability Maintenance Free Battery for Air Force aircraft, and qualifying Heat-To-Shrink Couplings technology for repair of damaged aircraft hydraulic lines. The payoffs from all of these efforts will be systems/subsystems that are significantly more reliable, are easier to fix, less susceptible to combat damage, and require fewer personnel and equipment to maintain. Based on a historical rate of return on investment of approximately 30 to 1, these 39 projects will provide the Air Force with over $400 million in operations and support cost avoidance savings.

(3) (U) FY 1988 Planned Program and Basis for FY 1988 RDT&E Request: As indicated earlier, interest in the PRAM program has skyrocketed. This intensified interest was brought about by an aggressive communications effort specially aimed at the using commands who have firsthand knowledge of their system's R&M problems. As a result, the number of potential projects has dramatically increased. As of this date, PRAM has reviewed 75 projects for application of its FY 1988 funding. Unfortunately, due to fiscal constraints, only about 30 of these projects will be undertaken. Included in these are prototyping, evaluating and qualifying improvements to; the Vulcan (30 mm) gun, the Air Force Turbine Engine Test Stand Instrumentation, AIM-9 Power Supply, F-15 Landing Gear Wiring and Switches, and the E-4B Auxiliary Power Unit. In addition, PRAM will develop an airborne platform for developmental test and evaluation of advanced radars and electronic counter-counter measure techniques, fabricate and qualify an Aircraft Hot Bonded Repair System (for both composite and metal components), and prototype a Stationary Neutron Radiography System for detection of low-level corrosion in aircraft parts. As with all other PRAM projects, the benefits derived from these efforts will substantially increase the combat capability and supportability of the recipient system. In term of cost avoidance savings, the Air Force will realize an estimated $600 million from the FY 1988 initiatives. The increase in FY 1988 funding is consistent with and an essential element of the Air Force's commitment to improve the reliability and maintainability of its fielded systems.

(4) (U) FY 1989 Planned Program and Basis for FY 1989 RDT&E Request: The projects list for FY 1989 is well on its way to being completed. At this juncture, PRAM has 36 projects under review for application of FY 1989 funding. These projects include prototyping and qualifying R&M improvements to; C-141 Cockpit Indicators, F-111 Master Frequency Generator, F-15 Fuel Tank Sealant, Ferrite Repair, T-43 APQ 122 radar, and Automated Wire Harness Techniques. Like FY 1988, we anticipate the Air Force we derive an estimated $600 million in cost avoidance savings plus immeasurable gains in combat capability and supportability from these efforts.

(5) (U) Program to Completion: This is a continuing program.

C. (U) Major Milestones: Not applicable.

9. (U) COOPERATIVE AGREEMENTS: Not applicable

FY 1988/FY 1989 RDT&E DESCRIPTIVE SUMMARY

Program Element: 01004F
DOD Mission Area: 460, International Cooperative RDT&E

Title: International Activities
Budget Activity: 6, Defense-Wide Mission Support

1. (U) RDT&E RESOURCES (PROJECT LISTING): ($ in thousands)

Project Number	Title	FY 1986 Actual	FY 1987 Estimate	FY 1988 Estimate	FY 1989 Estimate	Additional to Completion	Total Estimated Cost
TOTAL FOR PROGRAM ELEMENT		2,767	2,721	3,123	3,156	Continuing	N/A
2446	von Karman Institute	375	375	375	375	Continuing	N/A
2447	SHAPE Technical Centre/ AGARD/Coop R&D	2,392	2,346	2,748	2,781	Continuing	N/A

2. (U) BRIEF DESCRIPTION OF ELEMENT AND MISSION NEED: This program satisfies Department of Defense (DOD) administrative agent responsibilities for the North Atlantic Treaty Organization (NATO) Advisory Group for Aerospace Research and Development (AGARD) in Paris, France and for the Supreme Headquarters Allied Powers Europe (SHAPE) Technical Centre (STC) in The Hague, Netherlands; pays for United States scientists at STC; supports United States Air Force participation in cooperative Research and Development (R&D) agencies and groups; and pays the United States' share of NATO support for the von Karman Institute in Brussels, Belgium. Support of this program is a continuing international commitment under the auspices of NATO and our mutual weapons development agreements with our allies.

3. (U) COMPARISON WITH FY 1987 DESCRIPTIVE SUMMARY: ($ in thousands)

RDT&E	2,956	2,744	3,128	N/A	Continuing	N/A

4. (U) OTHER APPROPRIATION FUNDS: Not Applicable.

5. (U) RELATED ACTIVITIES: Supports international cooperative R&D agreements, Information Exchange Projects, the US Mutual Weapons Development Data Exchange Program, the Technology Cooperation Program with the United Kingdom, Canada, Australia, and New Zealand, the Defense Research Group, and the US Air Force Senior National Representative to the Under Secretary of Defense for Research and Engineering. Also supports USAF participation in NATO Armaments research, development and acquisition initiatives including representation on groups and subgroups under the NATO Conference of National Armaments Directors and the NATO Air Force Armaments Group.

6. (U) WORK PERFORMED BY: Leading US civilian and military scientists, engineers, and administrators. The Special Assistant for International Cooperative R&D, Deputy Chief of Staff for Research, Development and Acquisition, Headquarters USAF, administers the program.

7. (U) PROJECTS LESS THAN $10 MILLION IN FY 1988 AND/OR FY 1989:

A. (U) Project: 2446, von Karman Institute. Funds US share of North Atlantic Treaty Organization (NATO) support to the von Karman Institute for Fluid Dynamics in Brussels, Belgium. This international research facility is instrumental in advancing the state-of-the-art in fluid dynamics and related disciplines. The von Karman Institute was founded in 1956 under NATO auspices as an international, non-profit, scientific organization. Financial support comes from the supporting nations (57%), Belgian national support (13%) and research grants or international contracts (30%). US share of the 57% internationally-funded portion is 12.5%, for cooperative basic research with other NATO nations. US von Karman Institute Fellowships support up to five US participants annually. In FY 1986 the Institute graduated over 70 internationally trained scientists, conducted ten lecture series involving over 1000 NATO scientists/engineers, and published numerous technical reports. Continuing the US contribution will provide a flow of internationally educated scientists who return this expertise to their own countries. A program of cooperation between the von Karman Institute and the Air Force Institute of Technology (AFIT) was also initiated in FY 1986.

B. (U) Project: 2447, SHAPE Technical Centre/Advisory Group for Aerospace Research and Development (AGARD)/Cooperative Research and Development (R&D). The Supreme Headquarters Allied Powers Europe (SHAPE) Technical Centre (STC) is a multinational organization responsible directly to the Supreme Allied Commander, Europe. The Centre provides scientific and technical advice on military problems with emphasis on Command, Control and Communications. The United States Air Force (USAF), as administrative agent, supports 21 of 110 international scientist and engineer positions at STC. AGARD provides technical advice and assistance to the NATO Military Committee, promotes advances and cooperation in aerospace sciences and provides assistance to requesting NATO member nations to help increase their aerospace scientific and technical potential. The USAF is also administrative agent for AGARD and funds non-government as well as USAF participation in the AGARD scientific and technical meetings. This includes contracting for special services such as language translation for meetings in the US. In addition, this program pays for USAF participation in data exchange and engineer exchange agreements with free world countries, and participation in those NATO agencies and groups in which USAF membership and participation is directed by treaty or other agreement. The continued funding of the 21 US scientists/engineers at STC will ensure that we have firsthand knowledge of NATO command and control systems; and supporting the participation of up to 100 experts in AGARD technical panels and working groups will foster cooperative programs. In addition, US treaty obligations will also be achieved in international cooperative RDT&E through participation in NATO working groups, conferences, and the Scientist/Engineer Exchange Program.

8. (U) PROJECT OVER $10 MILLION IN FY 1988 AND/OR FY 1989: Not Applicable.

9. (U) COOPERATIVE AGREEMENTS: This program, as the title indicates, deals entirely with International Cooperative RDT&E. See above for detailed explanation.

MAJOR IMPROVEMENTS AND CONSTRUCTION OF GOVERNMENT-OWNED FACILITIES FUNDED BY RDT&E

Department/Agency: Air Force Date: Dec 86

Part I. UTILIZATION OF SECTION 2353, TITLE 10 AUTHORITY

Specialized R&D facilities and/or equipment determined to be necessary for the performance of a contract for a military department for research and development may be constructed by or furnished to the contractor and funded from appropriations available for research, development, test and evaluation. The Congress enacted this legislation, 10 USC 2353, in 1956. This policy is executed through DOD Directive 4275.5. Under this policy, the Secretaries of Military Departments or their designees; and the Directors of Defense Agencies may approve facilities projects up to $3,000,000; the Director, Defense Research and Engineering approves projects exceeding $3,000,000. The Congress is notified in advance of starting any project involving construction, regardless of the dollar amount. The table below provides a summary of all such projects accomplished in FY 86 and planned in FY 87 and FY 88.

Facility/Equipment*	RDT&E Project Number	Contractor	Location	1986	Total Obligational Authority (Thousands of Dollars) 1987	1988	1989	1990
			SECTION 1					
			Projects Accomplished or Underway					
Building 1302B-Addition to Electronic Research Lab 1/*	63311F 63250F	MIT Lincoln Laboratory	Hanscom AFB, MA	900.0				
Building 1302C-Addition to Electronic Research Lab 1/*	63250F	MIT Lincoln Laboratory	Hanscom AFB, MA	1,479.5 (1)				
Addition to Secure Vault & Electronics Area 1/*	12424F	MIT Lincoln Laboratory	Haystack Observatory Millstone Hill Westford, MA	192.4				
Extension to Millstone Computer Area 1/*	12424F	MIT Lincoln Laboratory	Millstone Hill Westford, MA	280.0				
Titan 34D X-Ray Facility 2/	34111F	Chemical Systems Division	Vandenberg AFB CA	1,250.0	4,070.0			
Alter Integrate-Transfer-Launch (ITL) Facilities 1/	35119F	Martin Marietta	Cape Canaveral AFS, FL	17,400.0	19,300.0	11,100.0	7,100.0	

(172)

Facility/Equipment*	RDT&E Project Number	Contractor	Location	1986	1987	1988	1989	1990
				Total Obligational Authority (Thousands of Dollars)				

SECTION II

Projects Planned or Projected

Facility/Equipment*	RDT&E Project Number	Contractor	Location	1986	1987	1988	1989	1990
Medium Launch Vehicle Program 2/	35119F	(TBD)	Cape Canaveral AFS, FL		6,000.0	6,000.0		
AFSTC/OL-AA, Malabar FL Malabar Advanced Telescope System 1/*	64710F	ITEK Corp	Malabar Test Annex (ESMC) Malabar FL		800.0	1,200.0		
Titan IV Facilities 2/	35119F	Martin Marietta	Vandenberg AFB, CA		70,000.0			
Building 1302J-Addition to Electronic Research Lab 1/*	63250F	MIT Lincoln Laboratory	Hanscom AFB, MA		2,450.0			
Building 1302N-Addition to Chemical Stock Facility 1/	63250F	MIT Lincoln Laboratory	Hanscom AFB, MA		294.0			
Building 1302F-Addition to Electronic Research Lab 1/	63250F	MIT Lincoln Laboratory	Hanscom AFB, MA		1,925.0			
Building 1312L-Addition to Electronic Research Lab 1/	12424F	MIT Lincoln Laboratory	Hanscom AFB, MA		596.0 (2)			
Building 1302B-Addition to Electronic Research Lab 2/	63250F	MIT Lincoln Laboratory	Hanscom AFB, MA		1,286.0			
Building 1302D-Addition to Electronic Research Lab 1/	63250F	MIT Lincoln Laboratory	Hanscom AFB, MA		517.0			
Building 1302C-Addition to Electronic Research Lab 1/*	63250F	MIT Lincoln Laboratory	Hanscom AFB, MA		295.0 (3)			
Building 1302E-Addition to Electronic Research Lab 1/	63250F	MIT Lincoln Laboratory	Hanscom AFB, MA		1,565.0			

Facility/Equipment*	RDT&E Project Number	Contractor	Location	1986	1987	1988	1989	1990
				Total Obligational Authority (Thousands of Dollars)				

SECTION II (Cont'd)

Projects Planned or Projected

Building 1302B 1/*	63431F	MIT Lincoln Laboratory	Hanscom AFB, MA		1,286.0			
Extension to L-Band Transmitter High-Bay Area 1/*	12424F	MIT Lincoln Laboratory	Millstone Hill Westford, MA			405.0		
Compact Antenna Range 2/	63311F	MIT Lincoln Laboratory	Hanscom AFB, MA		1,000.0	820.0		
Near Field Anechoic Chamber 2/	63424F	MIT Lincoln Laboratory	Hanscom AFB, MA		1,014.0			
Computer Test Lab 3/	12424F	MIT Lincoln Laboratory	Millstone Hill Westford, MA			910.0		

(1) 1,071.7K BOI funds added for total project cost of 2,679.2K.
(2) 1,191.0K BOI funds added for total project cost of 1,787.0K.
(3) 2450.0K BOI funds added for total project cost of 345.0K.

(1124)

MAJOR IMPROVEMENTS AND CONSTRUCTION OF GOVERNMENT-OWNED FACILITIES FUNDED BY RDT&E

Part 2. UTILIZATION OF RDT&E APPROPRIATION FOR FACILITIES AT GOVERNMENT-OWNED/GOVERNMENT-OPERATED INSTALLATIONS

DoD Manual 7110-1-M provides that RDT&E appropriations may finance the development, design, purchase and installation (including directly related foundations, shielding environmental control, weather protection, structural adjustments, utilities and access) of equipment or instrumentation required for research, development, test and evaluation activities. Facilities which are consumed in R&D test and evaluation, prototype facilities/equipment, and temporary facilities are also financed as part of the R&D appropriation involved since their intended utility expires when a test is completed. (Note: Contractor-Operated facilities are included in Part 1). The table below provides a summary listing of all such projects for the installation of equipment, where the cost of installation is more than $200,000, accomplished in FY 86 and planned in FY 87, FY 88, FY 89.

Facility/Equipment	RDT&E Project Number	Contractor	Location	1986	Total Obligational Authority (Thousands of Dollars) 1987	1988	1989	1990
			SECTION 1					
			Projects Accomplished or Underway					
			A. Equipment Installation					
Test Facility Space Transportation System 1/*	64411F		Vandenberg AFB, CA	4,900.0				
Test Facilities MOCC Evaluation 2/.	64627		Kirtland AFB, NM	295.0				
Install Class 100 Clean Room 1/*	62204F		Wright Patterson AFB, OH	469.9	267.3			
Modify Gasdynamics Facility 1/	BQ 82-9146		Wright Patterson AFB, OH	196.9	31.2			
Modernize Component Research Air Facility 1/*	62203F		Wright Patterson AFB, OH Bldgs 18B, 18C, and 18E		400.0			
Small ICBM Program 1/	Various	Various	Various	2,300.0	4,100.0			

Facility/Equipment	RDT&E Project Number	Contractor	Location	1986	1987	1988	1989	1990
				Total Obligational Authority (Thousands of Dollars)				

SECTION 1 (Cont'd)

Projects Accomplished or Underway

A. Equipment Installation

Facility/Equipment	RDT&E Project Number	Contractor	Location	1986	1987	1988	1989	1990
Cofferdam Concept Test Program 1/	Various	Various	Various	2,000.0	13,000.0			
Peacekeeper in Minuteman Silos 1/	Various	Various	Various	7,900.0	4,200.0	1,600.0	800.0	
Peacekeeper Follow-On Basing Program 1/	Various	Various	Various	77,800.0	6,400.0	5,300.0		
TAC Implementation 1/*	65807F		Arnold AFB, TN	499.0	437.0	450.0		
Test Facility Plant Automation 1/*	65807F		Arnold AFB, TN	331.0	159.0	284.0	197.0	144.0
AEDC Cell C-1 & C-2 Vector/Reverse Thrust 1/ *	64755F		Arnold AFB, TN	1,350.0	200.0			
Facility Computer & Network Improvement 1/*	65807F		Arnold AFB, TN	4,150.0	5,500.0	3,200.0	2,300.0	
C-1 Joint Technology Demonstration Engine 1/*	64755F		Arnold AFB, TN	670.0	125.0			
Upgrade Arc Heater 1/*	64755F		Arnold AFB, TN	1,430.0	1,055.0	1,120.0	302.0	
Equipment Installation Space Transportation System 1/*	64411F		6595th Shuttle Test Group, Vandenberg AFB, CA	10,600.0				
Full Field of View Dome Display Development 1/*	558-000	Not Awarded	Williams AFB, AZ				450	

1126

Facility/Equipment	RDT&E Project Number	Contractor	Location	Total Obligational Authority (Thousands of Dollars) 1986	1987	1988	1989	1990
			SECTION I (Cont'd)					
			Projects Accomplished or Underway					
			B. Test					
Aircraft Shelter Test Article 1/*	64617F		Various	2,600.0				
			C. Prototype					
North Warning System (NWS), Unattended Short Range Radar Facility 1/*	12412F		Bar Main Dew Line Station, Barter Island, AK	9,925.0				
			D. Temporary					
			(None)					

Part 2. (Cont'd)

Facility/Equipment	RDT&E Project Number	Contractor	Location	1986	1987	1988	1989	1990
					Total Obligational Authority (Thousands of Dollars)			

SECTION II

Projects Planned or Projected

A. Equipment Installation

Facility/Equipment	RDT&E Project Number	Contractor	Location	1986	1987	1988	1989	1990
Aerodynamic and Propulsion Test Unit 2/ (a)	65807F		AEDC Arnold AFS, TN		1,000.0	1,300.0	10,000.0	2,280.0
G-Range Electromagnetic Accelerator (EMA) 2/ (b)	65807F		AEDC Arnold AFS, TN		500.0	100.0	6,200.0	
X-Ray Radiation Effects Test Capabilities 2/ (b)	65807F		AEDC Arnold AFS, TN		300.0	4,000.0	-	
Wall Interference Assessment/Corrections Systems 2/ (a)	65807F		AEDC Arnold AFS, TN				500.0	500.0
Propulsion Facility Upgrade 2/ (a)	65807F		AEDC Arnold AFS, TN				4,000.0	
Infrared Sensor and Focal Plane Array Test Facilities 2/ (b)	65807F		AEDC Arnold AFS, TN				5,800.0	1,000.0
Advanced Hypersonic Facilities Complex 2/ (b)	65807F		AEDC Arnold AFS, TN			3,000.0	1,000.0	7,500.0
Freejet Test Cell C-2 2/ (a)	65807F		AEDC Arnold AFS, TN				370.0	103.0
Flexible Nozzle Tunnel for 4T (a) 2/	65807F		AEDC Arnold AFS, TN		87.4	759.0		

1128

Part 2. (Cont'd)

Facility/Equipment	RDT&E Project Number	Contractor	Location	1986	1987	1988	1989	1990
				Total Obligational Authority (Thousands of Dollars)				
SECTION II								
Projects Planned or Projected								
A. Equipment Installation								
Equipment Installation F-16 Radar and ECCM Testing 1/	27133F		AFFTC Edwards AFB, CA	300.0	250.0	250.0		
Equipment Installation F-15 Avionics Test (EFAST) 1/	27130F		AFFTC Edwards AFB, CA	250.0	250.0	500.0		
Mission Control Center Uninterruptable Power System for Critical Computer Circuits 2/			AFFTC Edwards AFB, CA			150.0	150.0	
Equipment Installation for Electrical and Air Conditioning for B-1 2/	64226F		AFFTC Edwards AFB, CA			1,900.0		
Test Facility - Space Transportation System 1/	64411F		Vandenberg AFB, CA		4,000.0			
Test Facility - Space Transportation System 2/	35171F		Vandenberg AFB, CA			4,000.0	5,000.0	7,000.0
Locate/Construct Site for Airborne Imagery Transmitter (ABIT) 1/*	63717F		Wright Patterson AFB, OH				250.0	
Install Secure TEMPEST Area. 1/	64739F		Wright Patterson AFB, OH, Bldg 620		900.0			

Part 2. (Cont'd)

Facility/Equipment	RDT&E Project Number	Contractor	Location	1986	1987	1988	1989	1990
				Total Obligational Authority (Thousands of Dollars)				

SECTION II (Cont'd)

Projects Planned or Projected

A. Equipment Installation

Facility/Equipment	RDT&E Project Number	Contractor	Location	1986	1987	1988	1989	1990
Install Electromagnetic Systems Simulator 1/*	63109F		Wright Patterson AFB, OH, Bldg 620		250.0			
Install Reconfigurable Electronic Combat Simulator 2/	64738F		Wright Patterson AFB, OH, Bldg 620				1,500.0	
Install Combustion Air Heaters & Exhaust System 1/*	62203F		Wright Patterson AFB, OH, Bldg 490			100.0	200.0	450.0
Turbine Research Lab 2/	62203F		Wright Patterson AFB, OH, Bldg 18C			300.0		
Equipment Installation of CRAY X-MP/48 Computer System 2/	62201F/62202F/ 62203F/62204F		Wright Patterson AFB, OH			400.0		
WIS Development & Evaluation Facility (DEF) Shielded Test Facility 1/	33152F		Hanscom AFB, MA Bldg 1302F Annex		1,700.0	640.0		
Fighter Lead-In Trainer 1/	63227F	McDonnell Douglas	Williams AFB, AZ				123.0	
Small ICBM Program 1/			Various		7,900.0	40,200.0	11,400.0	5,000.0
Deep Basing Test Program 1/			Various		2,200.0	3,900.0	7,200.0	
Peacekeeper Follow-On Basing Program 1/			Various		22,300.0	66,500.0	32,900.0	1,000.0

Part B. (Cont'd)

Facility/Equipment	RDT&E Project Number	Contractor	Location	1986	1987	1988	1989	1990
					Total Obligational Authority (Thousands of Dollars)			
			SECTION II (Cont'd)					
			Projects Planned or Projected					
			B. Test					
Test Facility Aerial Hard Targets 1/	64327F		Eglin AFB, FL		1,300.0			
Test Facility - Comat Steel Arch Igloos Ph I 2/	63601F		UTTR, Utah		1,200.0			
Test Facility - Comat Steel Arch Igloos Ph II 2/	63601F		UTTR, Utah			560.0		
Retrofit/Redesigned Aircraft Shelter Test Article 2/	64617F		UTTR, Utah		4,200.0			
Test Facility-Reconstruct Concrete Target 2/	64612F/28030F/ 64602F		Eglin AFB, FL		463.0			
			C. Prototype					
Stationary Neutron Radiography System	78026		McClellan AFB, CA		4,150.0			

Part 2. (Cont'd)

Facility/Equipment	RDT&E Project Number	Contractor	Location	1986	1987	1988	1989	1990
					Total Obligational Authority (Thousands of Dollars)			

SECTION II (Cont'd)

Projects Planned or Projected

D. Temporary

Facility/Equipment	RDT&E Project Number	Contractor	Location	1986	1987	1988	1989	1990
Temporary Construction C-17A Airdrop Test Complex 2/	64231F		Edwards AFB, CA				4,730.0	
Temporary Construction Ski Jump Facility 2/	63307F		Edwards AFB, CA		350.0			

NOTE: • Cost, Scope and/or FY Change

1/ Listed in previous submittal
2/ Initial submittal

(a) Funding anticipated as a result of OSD directed Space Systems test capabilities (SSTC Study)

(b) Funding anticipated from combination of customers and/or AEDC resources.

MAJOR IMPROVEMENTS TO AND CONSTRUCTION OF GOVERNMENT-OWNED FACILITIES

FUNDED BY RDT&E

PART 3. UTILIZATION OF RDT&E APPROPRIATION FOR MINOR CONSTRUCTION

For in-house installations, construction projects in support of R&D for $200,000 or less are funded from RDT&E appropriations. Such expenditures are authorized by 10 USC 2805 and the applicable provisions of the current DOD Appropriation Act. Under this project approval at this level is authorized by the Major Command concerned, or delegated to R&D installation commanders as appropriate. The table below provides a summary total of such minor construction accomplished in FY 86, and the estimated amounts planned for FY 87 and FY 88. All minor construction projects must result in a complete and usable facility. In no event are two or more minor construction projects or minor and major construction projects to be contrived to form a usable facility:

SUMMARY OF MINOR CONSTRUCTION FUNDED BY RDT&E, AIR FORCE

	FY 1986	FY 1987	FY 1988	FY 1989	FY 1990
TOTAL PART 3	12,113.8	23,602.0	10,869.1	9,186.7	9,248.4
SUBTOTAL PART 1	21,701.9	112,390.0	20,435.0	7,100.0	
SUBTOTAL PART 2	133,828.6	93,803.4	138,443.0	95,694.0	24,977.0
SUBTOTAL PART 3	12,113.8	23,602.0	10,869.1	9,186.7	9,248.4
GRAND TOTAL	167,644.3	229,803.4	169,747.1	111,980.7	34,225.4

(1133)

1. COMPONENT	FY 1986/87 RDT&E FACILITIES PROJECT DATA	2. DATE
(AFSC) AIR FORCE		12 Nov 86

3. INSTALLATION AND LOCATION	4. PROJECT TITLE
VANDENBERG AFB CA (SAC)	CONSTRUCT X-RAY TEST CELLS

5. PROGRAM ELEMENT	6. CATEGORY CODE	7. PROJECT NUMBER	8. PROJECT COST ($000)
34111F	312-477		5,320.0

9. COST ESTIMATES

ITEM	[illegible]	QUANTITY	UNIT COST	COST [illegible]
Test Cell A	LS			500.0
Test Cell B	LS			500.0
Test Cell C	LS			1,300.0
Superstructure	LS			1,400.0
Crane	LS			540.0
Site Work	LS			15.0
Subtotal				4,255.0
Overhead & Profit (25%)				1,063.0
Total				5,318.0
(say)				5,320.0

10. DESCRIPTION OF PROPOSED INSTALLATION Construct three concrete test cells and overhead superstructure with 60-ton bridge crane. Cells are to provide radiological shielding for Titan rocket motor X-ray operations.

11. PROJECT: Construct test cells and superstructure at the Receiving Inspection Station, Bldg 945, open storage area. Test cells will be reinforced concrete of a thickness necessary to meet operational requirements of the X-ray tests. Superstructure will cover all three test cells and provide structural support for a 60-ton bridge crane needed to place rocket motor components in the cells. Widening of existing pavement will facilitate movement of the rocket motor transformer.

REQUIREMENT: As a result of the April 1986 Titan mishap, operational testing requirements have been modified. All Titan rocket motor components currently in storage at Vandenberg AFB must be X-rayed before they can be certified for flight.

CURRENT SITUATION: No facilities at Vandenberg AFB exist that can meet the operational requirements for X-ray testing of Titan rocket motor components.

IMPACT IF NOT PROVIDED: Titan rocket motor components will not be X-rayed and, therefore, cannot be certified for flight.

DD FORM 1391

PREVIOUS EDITIONS MAY BE USED INTERNALLY UNTIL EXHAUSTED

(1134)

1106

1. COMPONENT (AFSC) AIR FORCE	FY 19~~87~~ 88 RDT&E FACILITIES PROJECT DATA	2. DATE 14 Oct 86

3. INSTALLATION AND LOCATION	4. PROJECT TITLE
CAPE CANAVERAL AFS, FL	MEDIUM LAUNCH VEHICLE PROGRAM

5. PROGRAM ELEMENT	6. CATEGORY CODE	7. PROJECT NUMBER	8. PROJECT COST ($000)
35119F	312-477		12,000

9. COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
MEDIUM LAUNCH VEHICLE PROGRAM	LS			12,000
COST OF PURCHASED EQUIPMENT (NON-ADD)				TBD

10. DESCRIPTION OF PROPOSED RDT&E WORK: Modify launch facilities at Cape Canaveral AFS (either Launch Complexes 17 A and B, 36 A and B, 39 A and B, or 40, depending on the final contractor selected), to support the Medium Launch Vehicle (MLV) Program.

REQUIREMENT: A single contractor will be selected for Phase II of the MLV program with the single responsibility of providing the Air Force with a Medium Launch Vehicle to launch the Global Positioning System (GPS) satellite. This acquisition involves all nonrecurring, production and launch efforts to place 20 GPS satellite into orbit.

CURRENT SITUATION: The loss of the Space Shuttle Challenger and the expected downtime for the Shuttle program of at least 24 months, has resulted in the inability of the United States to deploy the GPS constellation during its essential time of operation. The resulting backlog of Shuttle payloads requires the development of a Medium Launch Vehicle to deploy the GPS satellite. The program calls for an initial launch capability (ILC) of January 1989 and the establishment of a 21 satellite GPS constellation by early 1991. Presently, four contractors are doing preliminary design work for Phase I of the MLV program. Upon completion of Phase I, Phase II will begin in February 1987 with the selection of a single contractor to produce and launch the GPS satellites. Due to the close proximity of the ILC and the necessary modifications to the launch facilities that will begin in early 1987, all launch facility milestones must be met on schedule.

1107 (1135)

1. COMPONENT		2. DATE
(AFSC) AIR FORCE	FY 19 87 / 88 RDT&E FACILITIES PROJECT DATA	14 Oct 86

3. INSTALLATION AND LOCATION

CAPE CANAVERAL AIR FORCE STATION, FL (AFSC)

4. PROJECT TITLE	5. PROJECT NUMBER
MEDIUM LAUNCH VEHICLE PROGRAM	

IMPACT IF NOT PROVIDED: If this project is interrupted or delayed, the MLV will not meet its required initial launch capability date resulting in the delayed completion of the GPS constellation requirements.

(1136)

1108

1137

1109

1 COMPONENT (AFSC) AIR FORCE	FY 19 87/89 RDT & E FACILITIES PROJECT DATA	2 DATE
3 INSTALLATION AND LOCATION VANDENBERG AFB CA (SAC)		4 PROJECT TITLE TITAN IV FACILITIES
5 PROGRAM ELEMENT 35119F	6 CATEGORY CODE 390-531	7 PROJECT NUMBER
		8 PROJECT COST ($000) 70,000

9. COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
Titan IV Facilities	LS			70,000
Cost of Purchased Equipment				(TBD)

10 DESCRIPTION OF PROPOSED RDT&E WORK: Construct new facilities for Titan IV and alter existing facilities at SLC-4E.

PROJECT: Modify and refurbish existing SLC-4 facilities and construct new facilities on North and South VAFB to support final assembly, integration, and launch of the Titan IV Expendable Launch Vehicle (ELV).

REQUIREMENT: The Titan IV contractor is responsible to provide and launch Titan IV ELVs from Vandenberg AFB into a polar orbit for critical DOD satellites. Existing facilities need to be modified to fit the larger launch vehicle and to provide support for the various vehicle stages and payload processing facilities. Initial launch is scheduled for January 1989.

CURRENT SITUATION: The existing SLC-4E MST is too small to permit stacking and servicing the Titan IV. ~~There are no existing facilities suitable for~~ processing the core vehicle and payload fairing. There are no adequate high bay facilities for storing processing contractor equipment.

IMPACT IF NOT PROVIDED: The contractor will be unable to meet the critical launch dates of security satellites.

1138

1110

1. COMPONENT AFSC AIR FORCE	FY 1987 RDT&E FACILITIES PROJECT DATA	2. DATE 14 Oct 1986

3. INSTALLATION AND LOCATION	4. PROJECT TITLE
Hanscom AFB, Massachusetts	Addition to Electronic Research Laboratory Building 1302E

5. PROGRAM ELEMENT	6. CATEGORY CODE	7. PROJECT NUMBER	8. PROJECT COST ($000)
63250F	317-315		1,286

9. COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
ADDITION TO ELECTRONIC RESEARCH LABORATORY, Building 1302E	SF	5,354	$200	$1,069
Architectural	LS			(802)
Mechanical	LS			(128)
Electrical	LS			(139)
SUBTOTAL				$1,069
CONTINGENCY 15%				150
SUBTOTAL				1,219
SIOH (5.5)				67
TOTAL FUNDED COST				1,286
DESIGN (NON-ADD)				100

10. DESCRIPTION OF PROPOSED INSTALLATION: Construct a second floor to Building E-100 which will extend and be connected to Building 1302D. It will provide 5354 sq. ft. of laboratory space, heating, air conditioning and lighting.

PROJECT: Construct an addition on the roof of Lincoln Laboratory Building 1302E for use as a laboratory.

REQUIREMENT: Laboratory space is required for an expanded effort in the LASERCOM program. An experimental optical space communications flight is scheduled to be launched in CY89. This system will be used to demonstrate low-power, highly secure long range wideband communications. The needed space will house facilities for optical, mechanical and electrical assembly of the experimental, test and final space packages. Delivery of the system to the satellite integrating contractor is scheduled for mid-CY88.

Space requirements for several special experimental and fabrication areas are necessary, and include dedicated optical bench facilities for critical alignment checks, and clean room areas for assembly of flight-qualified components.

CURRENT SITUATION: Lincoln Laboratory's facilities are furnished by the government to the contractor (MIT) for performance of various R&D programs. Additional laboratory space is needed for the expanding LASERCOM effort. Space is not available to house the project personnel and equipment.

IMPACT IF NOT PROVIDED: Continued overcrowding with resulting inefficiencies will affect progress in performance of the program objectives.

1. COMPONENT		2. DATE
AFSC AIR FORCE	FY 1987&88 RDT&E FACILITIES PROJECT DATA	15 Oct. 86

3. INSTALLATION AND LOCATION	4. PROJECT TITLE
Hanscom AFB, Massachusetts	Compact Antenna Range

5. PROGRAM ELEMENT	6. CATEGORY CODE	7. PROJECT NUMBER	8. PROJECT COST ($000)
63311F	3XX-XXX	MXRD-0602	1820

9. COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
COMPACT ANTENNA RANGE	SF	3500	$428.57	1500
Site Preparation	LS			(270)
Mechanical	LS			(274)
Architectural & Structure	LS			(400)
Electrical	LS			(244)
Fire Protection	LS			(312)
Subtotal				1500
Contingency (15%)				225
Subtotal				1725
SIOH (5.5%)				95
Total Funded Cost				1820
Design (Non-Add)				225

10. DESCRIPTION OF PROPOSED INSTALLATION

Provide a structure within Bldg. 1718 hangar to house a 70' x 50' compact radar cross section range.

REQUIREMENT: Increased space is needed to house a compact radar cross section range. The compact range will extend the measurement capabilities up to 100 GHz and provide for the measurement of targets up to 8 ft. long.

CURRENT SITUATION: Lincoln Laboratory is engaged in the development of advanced penetration aids for the Air Force. Cross section measurements must be made on these penetration aids prior to the collection of flight measurement data at the Kiernan Re-entry Measurements Site. With the addition of millimeter wave radars at the Kiernan Re-entry Measurements Site, there is a need to extend the maximum frequency of measurement. Currently, the facility is limited to a 126 GHz maximum frequency. The capability to measure targets up to 8' long is required; currently the target size is limited to ~3 ft.

IMPACT IF NOT PROVIDED: If the facility is not provided, measurements of large targets at high frequency cannot be made. This deficiency will prevent the Laboratory from meeting future requirements to design both large exo- and high frequency endo- penetration aids.

1. COMPONENT		2. DATE
AFSC AIR FORCE	FY 1987 RDT&E FACILITIES PROJECT DATA	15 Oct. 86

3. INSTALLATION AND LOCATION	4. PROJECT TITLE
Hanscom AFB, Massachusetts	Near Field Anechoic Chamber Facility

5. PROGRAM ELEMENT	6. CATEGORY CODE	7. PROJECT NUMBER	8. PROJECT COST ($000)
63424F	3XX-XXX	MXRD-87-0601	1014

9. COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
NEAR FIELD ANECHOIC CHAMBER FACILITY	SF	2280	$366.66	836
Architectural & Structure	LS			(340)
Mechanical	LS			(162)
Fire Protection	LS			(196)
Electrical	LS			(138)
Subtotal				836
Contingency (15%)				125.4
Subtotal				961.4
SIOH (5.5%)				52.6
Total Funded Cost				1014.0
Design (Non-Add)				120

10. DESCRIPTION OF PROPOSED INSTALLATION

An addition of a 2280 ft^2 building to be situated at Lincoln Laboratory for an anechoic chamber.

REQUIREMENT: The proposed building will house RF and mechanical equipment for the testing of phased array antennas. It is intended that the facility will be equipped for complete remote operation. Personnel will not be present during data taking or housed in the structure on a permanent basis.

CURRENT SITUATION: MIT Lincoln Laboratory is in the process of designing hardware for proof of concept demonstrations related to airborne and space based radar (SBR) performance in the areas of low sidelobe phased arrays, adaptive jammer nulling and clutter cancellation. In order to proceed with testing of advanced hardware currently in development, a near field testing facility, satisfying the special needs and specifications of key technology development goals, is required. Completion is anticipated to take place around the end of FY87. Use of the facility will continue in the foreseeable future in response to the evolving needs of relevant technology.

IMPACT IF NOT PROVIDED: Without this facility, timetables for the development of critical technology will in all probability be set back on a national scale as this facility will be uniquely qualified to resolve fundamental and critical questions on the effectiveness of key approaches, devices, components, algorithms, radar design and performance.

1. COMPONENT	FY 19 88 RDT&E FACILITIES PROJECT DATA	2. DATE
AFSC AIR FORCE		15 Oct. 86

3. INSTALLATION AND LOCATION	4. PROJECT TITLE
MIT Lincoln Laboratory Millstone Hill Field Station Westford, Massachusetts	Computer Test Laboratory

5. PROGRAM ELEMENT	6. CATEGORY CODE	7. PROJECT NUMBER	8. PROJECT COST ($000)
12424F	317-315	MXRD-0603	910

9. COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
COMPUTER TEST LABORATORY	SF	4000	$227.50	750
Electrical	LS			(200)
Mechanical	LS			(150)
Architectural	LS			(220)
Structural	LS			(180)
Subtotal				750
Contingency (15%)				112.5
Subtotal				862.5
SIOH (5.5%)				47.5
Total Funded Cost				910.0
Design (Non-Add)				75

10. DESCRIPTION OF PROPOSED INSTALLATION

An addition of a 4000 sq. ft. area to the Millstone Hill Radar Site.

REQUIREMENTS: The addition of a 4000 sq. ft. building to house RF and computer test laboratory including the personnel and equipment required to test, maintain and operate the installed systems.

CURRENT SITUATION: Lincoln Laboratory is engaged in the research and development of satellite tracking techniques at the Millstone Hill Radar Site, which include extended orbital position predictions, automated SOI, and deep space network control processing. R&D on the problems of detecting space objects in deep space are investigated and the ensuing techniques are incorporated into other sensors in the SPACETRACK Network. Recent major upgrades to this facility have introduced added RF, computing and signal processing equipment and a laboratory to test and maintain this equipment is required.

IMPACT IF NOT PROVIDED: The facility at the Millstone Hill Field Station is the center of operations for the Satellite Tracking Program. The recent upgrades have greatly increased the value of the radar as a key sensor in the Air Force Spacetrack Network. Failure to provide the expansion to house test equipment and personnel would jeopardize the Laboratory's ability to meet its requirements to this program.

1 COMPONENT	FY 19_86 RDT&E FACILITIES PROJECT DATA	2 DATE
AIR FORCE		30 Sep 86

3 INSTALLATION AND LOCATION	4 PROJECT TITLE
KIRTLAND AFB, NEW MEXICO	Test Facilities: BDCC Evaluation

5 PROGRAM ELEMENT	6 CATEGORY CODE	7 PROJECT NUMBER	8 PROJECT COST ($000)
64711F	141-18X	2895	$295.00

9 COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
Test Facility; BDCC Evaluation.	LS			$295.00
A. Test Structure.	LS			(194.50)
B. Site Preparation & Structure Installation.	LS			(100.50)
Total Funded Cost				$295.00
Excluded Costs (Non-add):	LS			$308.56
A. Instrumentation	LS			(160.37)
B. Testing	LS			(148.19)

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10 DESCRIPTION OF PROPOSED RDT&E WORK

Fabrication and installation of the test structure in the test bed, placement of instrumentation, and restoring the test site to the proper condition after each test.

11.

PROJECT: AFWL has been directed to assess the performance of the Base Damage Control Center (BDCC) in a conventional weapon environment. Information required for this assessment will be obtained from testing which exposes an instrumented BDCC to the environments produced by detonations of general purpose bombs. Test construction includes fabrication of a BDCC and installation of this test article in the test bed.

REQUIREMENT: USAFE intends to procure the BDCC and other facilities of this design, providing that this design performs satisfactorily in a combined chemical and conventional weapon environment. AFWL will perform the conventional weapon assessment for this shelter. USAFE requires the results of this assessment in order to make sound procurement decisions.

CURRENT SITUATION: AFWL is developing the test and instrumentation plans for this effort. The RFP is being finalized to obtain the precast concrete panels for its construction. The ground work has been layed to procure the equipment for this facility. The testing will be performed at McCormick Ranch, located on Kirtland AFB. A minimum of five tests using MK-83 bombs will be conducted. The design for this BDCC has not yet been tested for survivability in a chemical and conventional weapon environment

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1. COMPONENT AIR FORCE	FY 19 86 RDT&E FACILITIES PROJECT DATA	2. DATE 30 Sep 86
3. INSTALLATION AND LOCATION KIRTLAND AFB, NEW MEXICO		
4. PROJECT TITLE Test Facilities: BDCC Evaluation		5. PROJECT NUMBER 2895

11. (Continued)

IMPACT IF NOT PROVIDED: Collective protection of certain work areas in a combined chemical and conventional weapon environment is a vertical USAFE requirement. The results of the AFWL assessment are required to determine if the BDCC design will satisfy these protective requirements. Without this test article and tests, the protective capability of this structure will remain unknown and possibly expose personnel to unnecessary risks in the field.

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1. COMPONENT	FY 19 87 RDT & E FACILITIES PROJECT DATA	2. DATE
Air Force		31 Oct 86

3. INSTALLATION AND LOCATION	4. PROJECT TITLE
ARNOLD AFS, TN 37389-5000 COFFEE COUNTY, TN	EQUIPMENT INSTALLATION AERODYNAMIC AND PROPULSION TEST UNIT (APTU) UGRADE

5. PROGRAM ELEMENT	6. CATEGORY CODE	7. PROJECT NUMBER	8. PROJECT COST ($000)
65807F		920043	14,580

9. COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
EQUIPMENT INSTALLATION				
AERODYNAMIC AND PROPULSION TEST UNIT				
(APTU) UPGRADE:	LS			14,580
HIGH PRESSURE AIR STORAGE	LS			(2,280)
GAS GENERATOR STRUCTURES TESTING	LS			(1,000)
GAS GENERATOR PROPULSION TESTING				(1,300)
INSTALL CLEAN AIR HEATERS				(10,000)
COST OF PURCHASED EQUIPMENT (NON-ADD)				(13,920)
TOTAL EQUIP AND INSTALLATION COST (NON-ADD)				(28,500)
OTHER NON-ADD COSTS:				
DESIGN COST				(1,710)

10. DESCRIPTION OF PROPOSED CONSTRUCTION

DESCRIPTION OF PROPOSED INSTALLATION: Upgrade of this facility comprises the addition of 14,200 cubic feet of high pressure air storage, extending total pressure capability to 450 psia and adding clean and vitiated air heaters capable of providing air temperature to 2500°R and 6000°R respectively.

PROJECT: The proposed modifications will extend the facility capabilities for conducting flight simulation tests for development of ramjet and ducted rocket propulsion systems, and for thermal structure and materials testing.

REQUIREMENT: This improved test capability is critical to the development of high speed vehicles such as the transatmospheric vehicle, national aerospace plane, and the Army's high Endo - Atmospheric Defense Interceptor.

CURRENT SITUATION: The APTU facility is presently limited to stagnation pressure and temperature of 300 psia and 2000°R respectively, and air storage capacity of 22,000 cubic feet. These limitations will not allow adequate developmental testing of the high speed vehicles noted above.

IMPACT IF NOT PROVIDED: If this facility is not modified as proposed the new high speed vehicle development programs cannot be supported, resulting in program delay costs, and risks of flying with inadequate ground testing.

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1. COMPONENT	FY 19 87 RDT & E FACILITIES PROJECT DATA	2. DATE
Air Force		31 Oct 86

3. INSTALLATION AND LOCATION	4. PROJECT TITLE
ARNOLD AFS, TN 37389-5000 COFFEE COUNTY, TN	EQUIPMENT INSTALLATION G-RANGE ELECTROMAGNETIC ACCELERATOR (EMA)

5. PROGRAM ELEMENT	6. CATEGORY CODE	7. PROJECT NUMBER	8. PROJECT COST ($000)
65807F	390-155	--	6,800

9. COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
EQUIPMENT INSTALLATION				
G-RANGE ELECTROMAGNETIC ACCELERATOR (EMA)				6,800
PILOT EMA SYSTEM ADDITION (FY 87)				(500)
G-RANGE COUNTERFIRE UPGRADE (FY 88)				(100)
G-RANGE EMA ADDITION (FY 89)				(6,200)
COST OF PURCHASED EQUIPMENT (NON-ADD)				(40,800)
TOTAL EQPT AND INSTALL COST (NON-ADD)				47,600
OTHER NON-ADD COSTS:				
DESIGN COSTS				(4,900)

10. DESCRIPTION OF PROPOSED CONSTRUCTION

DESCRIPTION OF PROPOSED INSTALLATION: Project provides for addition of a pilot EMA system to an existing AEDC research facility; addition of a full-scale EMA to the AEDC G-range, and increases to the G-range test projectile velocity.

PROJECT: These additions increase launch velocities 50 to 100%. Existing power supply systems will be tripled to 3 million amperes and 300 million joules.

REQUIREMENT: These facility upgrades are required for testing reentry vehicle configurations and materials at hypervelocity conditions.

CURRENT SITUATION: Current weapons systems development trends exceed existing G-range capability.

IMPACT IF NOT PROVIDED: Timely and adequate ground testing will not be available for reentry vehicles, hypersonic projectiles, and EMA systems development.

1. COMPONENT	FY 19 87 RDT & E FACILITIES PROJECT DATA	2. DATE
Air Force		31 Oct 86

3. INSTALLATION AND LOCATION	4. PROJECT TITLE
ARNOLD AFS, TN 37389-5000 COFFEE COUNTY, TN	EQUIPMENT INSTALLATION X-RAY RADIATION EFFECTS TEST FACILITIES

5. PROGRAM ELEMENT	6. CATEGORY CODE	7. PROJECT NUMBER	8. PROJECT COST ($000)
65807F			4,300

9. COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
EQUIPMENT INSTALLATION				
X-RAY RADIATION EFFECTS TEST FACILITIES:	LS			4,300
12-FT RESEARCH SPHERE (FY 87)........	LS			(300)
PILOT X-RAY SYSTEM ADDITIONS (2 MODULES) (FY 88)	LS			(4,000)
COST OF PURCHASED EQUIPMENT (NON-ADD)				28,750
TOTAL EQUIPMENT AND INSTALL COST (NON-ADD)				(33,050)
OTHER NON-ADD COSTS:				
DESIGN COST.....................				(2,300)
CONCEPT VERFICIATION (FY 89)				(1,000)

10. DESCRIPTION OF PROPOSED CONSTRUCTION

DESCRIPTION OF PROPOSED INSTALLATION: Project provides for (1) modification of an existing vacuum sphere to contain a small X-ray machine, and (2) add a pilot facility to enclose a two module X-ray source, shielding, controls and support system.

PROJECT: Provides above-ground testing facilities which use non-nuclear X-ray radiation simulators for assessing radiation hardness and survivability of individual space systems electronic assemblies.

REQUIREMENT: The Joint Chiefs of Staff (JCS) criteria exists for satellite systems radiation-harness and survivability. These criteria drive the need for facilities which provide the capability to test and evaluate radiation upset phenomena and recovery modes for these satellite systems.

CURRENT SITUATION: Radiation effects testing is currently being conducted in undersized, low-energy facilities which provide only very limited test duration. New satellite systems and components cannot be adequately hardness tested in existing facilities.

IMPACT IF NOT PROVIDED: Without this testing capability, satellites will be placed in orbit with questionable and unknown survivability levels.

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1. COMPONENT		2. DATE
Air Force	FY 19 89 RDT & E FACILITIES PROJECT DATA	31 Oct 86

3. INSTALLATION AND LOCATION	4. PROJECT TITLE
ARNOLD AFS, TN 37389-5000 COFFEE COUNTY, TN	EQUIPMENT INSTALLATION WALL INTERFERENCE ASSESSMENT/CORRECTIONS SYSTEMS

5. PROGRAM ELEMENT	6. CATEGORY CODE	7. PROJECT NUMBER	8. PROJECT COST ($000)
658074	312-477	ANZY880203(R-2)	1,000

9. COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
EQUIPMENT INSTALLATION				
WALL INTERFERENCE ASSESSMENT/CORRECTION				
SYSTEMS:				1,000
4-T WIND TUNNEL (FY 89)..............	LS			(500)
16-T WIND TUNNEL (FY 90)............	LS			(500)
COST OF PURCHASED EQUIPMENT (NON-ADD)...				(5,000)
TOTAL EQUIPMENT AND INSTALLATION COST (NON-ADD)				(6,000)
OTHER NON-ADD COSTS:				
DESIGN COST.........................				(150)

10. DESCRIPTION OF PROPOSED CONSTRUCTION

DESCRIPTION OF PROPOSED INSTALLATION: Install a new Wall Interference Assessment/Correction (WIAC) System. Work includes modifications to existing test sections in Wind Tunnels 4-T and 16-T and installation of pressure measurement equipment and data analysis systems.

PROJECT: Provide modified test sections, pressure measurement equipment, and data analysis systems to permit transonic wall interference assessment/correction of aerodynamic data taken on missile and aircraft models.

REQUIREMENT: Accurate force and moment data is required from model tests in the AEDC transonic wind tunnels. The proposed system will greatly reduce data uncertainties now attributed to wall interference effects.

CURRENT SITUATION: Transonic wind tunnel data uncertainties currently existing in AEDC test data cannot be tolerated. Technology exists for removing these uncertainties by installation of the proposed systems.

IMPACT IF NOT PROVIDED: Without the proposed systems, tunnel wall interference phenomena will continue to affect test data. These test data uncertainties will increase system development risks, cost and cause schedule delays.

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1. COMPONENT	FY 19 89 RDT & E FACILITIES PROJECT DATA	2. DATE
Air Force		21 Oct 86

3. INSTALLATION AND LOCATION	4. PROJECT TITLE
ARNOLD AFS, TN 37389-5000 COFFEE COUNTY, TN	EQUIPMENT INSTALLATION PROPULSION FACILITY UPGRADE

5. PROGRAM ELEMENT	6. CATEGORY CODE	7. PROJECT NUMBER	8. PROJECT COST ($000)
65807F			4,000

9. COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
EQUIPMENT INSTALLATION PROPULSION FACILITY UPGRADE				4,000
CRYOGENIC SYSTEMS INSTALL (FY 89)				(2,000)
UTILITIES/UPGRADE OF CELLS J-2A AND T-3 (FY 89)				(2,000)
COST OF PURCHASED EQPT (NON-ADD)				(6,000)
TOTAL EQUIP AND INSTALL COST (NON-ADD)				10,000
OTHER NON-ADD COST:				
DESIGN COST				(600)

10. DESCRIPTION OF PROPOSED CONSTRUCTION

DESCRIPTION OF PROPOSED INSTALLATION: Reactivate high altitude space propulsion test cell J-2A and upgrade test cell T-3 for cryogenic fuel utilization. Also increase the supporting plant capability for temperature/pressure simulation.

PROJECT: The reactivation and improvement of these test units will provide a timely and comprehensive test and evaluation capability for SDI systems, orbital maneuvering vehicle, and the orbital transfer vehicle.

REQUIREMENT: Successful development of future space propulsion systems is tied to ground development testing of these systems. Reactivation of these test cells will provide the needed test facility capability.

CURRENT SITUATION: Currently there are no national facilities for long duration, high altitude liquid rocket testing.

IMPACT IF NOT PROVIDED: There will be no DOD capability to test cryogenic propulsion systems for space vehicles. Development of new technology space propulsion systems will be impacted by the lack of ground test capability.

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1. COMPONENT	FY 19 89 RDT & E FACILITIES PROJECT DATA	2. DATE
Air Force		31 Oct 86

3. INSTALLATION AND LOCATION	4. PROJECT TITLE
ARNOLD AFS, TN 37389-5000 COFFEE COUNTY, TN	EQUIPMENT INSTALLATION INFRARED SENSOR AND FOCAL PLANE ARRAY TEST FACILITIES

5. PROGRAM ELEMENT	6. CATEGORY CODE	7. PROJECT NUMBER	8. PROJECT COST ($000)
65807F	310-926		6,800

9. COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
EQUIPMENT INSTALLATION				
INFRARED SENSOR AND FOCAL PLANE				
ARRAY TEST FACILITIES: -	LS			6,800
MARK I INFRARED SENSOR (FY 89)	LS			(5,800)
10V FOCAL PLANE ARRAY (FY 90)	LS			(1,000)
COST OF PURCHASED EQUIPMENT (NON-ADD)				(23,200)
TOTAL EQUIP AND INSTALLATION COST (NON-ADD)				(30,000)
OTHER NON-ADD COSTS:				
DESIGN STUDIES/COSTS				(2,800)

10. DESCRIPTION OF PROPOSED CONSTRUCTION

DESCRIPTION OF PROPOSED INSTALLATION: The AEDC Mark I aerospace chamber will be modified to include a helium cooled liner, infrared generator, optics equipment, handling systems, build up area, and a clean room. The AEDC 10V aerospace chamber will be modified to accommodate focal plane arrays by removal of existing cryogenic liners, adding gaseous helium shrounds, a 10°Kelvin cryostat and an infrared generator.

PROJECT: These chamber modifications will provide for infrared sensor testing and focal plan array testing.

REQUIREMENT: These modified facilities will adequately support development testing of the new generation orbital based infrared surveillance and tracking sensors which are a vital part of the Strategic Defense Initiative (SDI) program.

CURRENT SITUATION: Present sensor testing is limited to our seven-foot chamber which will not accept the larger future test items. No other larger chamber is equipped to provide the needed test environment.

IMPACT IF NOT PROVIDED: If these facilities are not modified as proposed, the new one meter class surveillance sensors cannot be adequately system evaluated in the required simulated space environment. Also, the large arrays cannot be tested in the correct space environment unless the 10V AEDC chamber is modified as proposed.

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1. COMPONENT		2. DATE
Air Force	FY 19 89 RDT & E FACILITIES PROJECT DATA	31 Oct 86

3. INSTALLATION AND LOCATION	4. PROJECT TITLE
ARNOLD AFS, TN 37389-5000 COFFEE COUNTY, TN	EQUIPMENT INSTALLATION ADVANCED HYPERSONIC FACILITIES COMPLEX

5. PROGRAM ELEMENT	6. CATEGORY CODE	7. PROJECT NUMBER	8. PROJECT COST ($000)
65807F		ANZY 90091	18,500

9. COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
EQUIPMENT INSTALLATION				
ADVANCED HYPERSONIC FACILITIES COMPLEX	LS			18,500
PHASE I POWER SUPPLY (FY 88)........	LS			(3,000)
PHASE I ARCH HEATER (FY 89)	LS			(1,000)
PHASE I NOZZLE AND TEST CELL 1 (FY 90)	S			(4,500)
DATA ACQUISITION SYSTEM (FY 90)	LS			(2,000)
HIGH PRESSURE AIR SUPPLY (FY 90)	LS			(1,000)
TEST CELL CONTROL SYSTEM (FY 90)	LS			(500)
PHASE II POWER SUPPLY (FY 91)	LS			(2,000)
TEST CELL 2 (FY 91)	LS			(5,000)
COST OF PURCHASED EQUIPMENT (NON-ADD)				(83,200)
TOTAL EQUIPMENT INSTALLATION AND COST (NON-ADD)				101,700
OTHER NON-ADD COSTS:				
DESIGN COSTS				(6,300)
INSTRUMENTATION AND TEST CELL ACTIVATION				(10,000)

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10. DESCRIPTION OF PROPOSED CONSTRUCTION

DESCRIPTION OF PROPOSED INSTALLATION: Proposed installation includes addition of two hypersonic wind tunnel test cells with arc heaters, nozzles, test sections, diffusers, exhaust system, data acquisition system, and instrumentation. An existing AEDC air supply will be used.

PROJECT: These two advanced arc driven hypersonic wind tunnels will provide true temperature flight simulation over Mach 6-18. There will be a propulsion and an aerothermal test leg for testing full-scale components of advanced missiles, ramjets and hypersonic vehicles.

REQUIREMENT: In order for the US to move into the hypersonic vehicle era, newer, high performance test facilities are needed. Development of a national aerospace plane will require the developmental facilities as proposed.

CURRENT SITUATION: Existing facilities to support high speed flight cannot adequately simulate the needed test conditions to support development of hypersonic vehicles.

IMPACT IF NOT PROVIDED: Without the proposed complex of hypersonic test facilities; test data and computer models for design of hypersonic vehicles will not be available; and the development risk will be very high.

1. COMPONENT	FY 19 87 RDT & E FACILITIES PROJECT DATA	2. DATE
Air Force		31 Oct 86

3. INSTALLATION AND LOCATION	4. PROJECT TITLE
ARNOLD AFS, TN 37389-5000 COFFEE COUNTY, TN	EQUIPMENT INSTALLATION FREEJET PROJECT IN TEST CELL C-2

5. PROGRAM ELEMENT	6. CATEGORY CODE	7. PROJECT NUMBER	8. PROJECT COST ($000)
65807F			473

9. COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
EQUIPMENT INSTALLATION ATTACHMENT OF EQUIPMENT IN CELL C-2 TO SUPPORT FREEJET ENGINE TESTING				473
ACQUISITION OF EQUIPMENT FOR TEST CELL C-2 (Non-add)				(14012)
TOTAL COST				14485

10. DESCRIPTION OF PROPOSED CONSTRUCTION

DESCRIPTION OF PROPOSED INSTALLATION: Freejet testing capability is required in AEDC test cell C-2 for airframe/propulsion system integration testing for current and new technology aircraft and turbine engines. These aircraft and comparable missile systems incorporate new technologies such as blended inlets and exhausts; integrated avionics, propulsion and armament systems; vectoring and reversing nozzles; and low infrared and radar observables. The effective integration of these capabilities determines how successfully a weapon system accomplishes its mission. Improper integration between the airframe and its propulsion system will severely limit the capability of the aircraft or missile by impacting range, payload, and maneuverability and by increasing operating costs.

REQUIREMENT: AEDC test cell C-2 will be used to conduct freejet testing of the Air Force's next major fighter aircraft program, the Advanced Tactical Fighter (ATF), and other system integration efforts.

CURRENT SITUATION: AEDC test cells currently do not have a freejet capability. To accomplish the objectives of the ATF Propulsion System Integration Test, special equipment (attitude positioning mechanism, subsonic and supersonic nozzles, air capture ducts, engine mounting pedestal, and forebody simulators) which is not applicable to other types of engine tests are required to conduct the freejet tests.

IMPACT: Approval of the RDT&E facilities project is necessary to meet the ATF program development shedule.Testing is scheduled to begin in mid-FY90.

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1. COMPONENT		2. DATE
Air Force	FY 19_88 RDT & E FACILITIES PROJECT DATA	31 Oct 86

3. INSTALLATION AND LOCATION	4. PROJECT TITLE
ARNOLD AFS, TN 37389-5000 COFFEE COUNTY, TN	EQUIPMENT INSTALLATION FLEXIBLE NOZZLE FOR TUNNEL 4T

5. PROGRAM ELEMENT	6. CATEGORY CODE	7. PROJECT NUMBER	8. PROJECT COST ($000)
65807F	390-614	805020	846

9. COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
EQUIPMENT INSTALLATION				
FLEXIBLE NOZZLE FOR TUNNEL 4T	LS			846
EQUIPMENT INSTALLATION	LS			(846)
COST OF PURCHASED EQUIPMENT (Non-Add)	LS			(1200)
TOTAL EQUIP & INSTALLATION COST (Non-ADD)	LS			2046
OTHER NON-ADD COSTS				(2200)
DESIGN COSTS				(600)

10. DESCRIPTION OF PROPOSED CONSTRUCTION

DESCRIPTION OF PROPOSED INSTALLATION: Install a flexible nozzle system in Tunnel 4T to allow continuous Mach number variations from 0.2 to 2.0. This will include installation of a new nozzle, new control system, and an extension of the existing Tunnel 4T instrument room.

REQUIREMENT: The capabilities of Tunnel 4T must be upgraded to match the capabilities present and future fighter aircraft since this tunnel is the primary Air Force facility used to certify proper separation of weapon stores from combat aircraft.

CURRENT SITUATION: Tunnel 4T now has the capability of continuous Mach number variations for 0.2 to 1.3 and at 1.6 and 2.0 using nozzle inserts. Steps must be taken to fill the gap that exist in the Mach coverage from 1.3 to 2.0.

IMPACT: With the 1.6 and 2.0 nozzle inserts, serious gaps in the Mach coverage from 1.3 to 2.0 exists such that certification of aircraft/store compatibility for some supersonic aircraft is not possible.

DD FORM 1 DEC 76 1391 — PREVIOUS EDITIONS MAY BE USED INTERNALLY UNTIL EXHAUSTED — PAGE NO. 1

1. COMPONENT	FY 1989 RDT & E FACILITIES PROJECT DATA	2. DATE
AIR FORCE (AFSC)		12 DEC 86

3. INSTALLATION AND LOCATION	4. PROJECT TITLE
EDWARDS AIR FORCE BASE, CALIFORNIA	EQUIPMENT INSTALLATION: UPS FOR MISION CONTROL CENTER

5. PROGRAM ELEMENT	6. CATEGORY CODE	7. PROJECT NUMBER	8. PROJECT COST ($000)
65807	317-315	890506 (80-22)	150.0

9. COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
EQUIPMENT INSTALLATION				
UPS FOR RIDELY MISSION CONTROL CENTER				150
ELECTRICAL MODIFICATIONS	LS			(150)
COST OF PURCHASED EQUIPMENT (NON-ADD)				(470)
TOTAL EQUIPMENT & INSTALLATION COST				620
OTHER NON-ADD COST				
DESIGN (10%)				(15)

10. DESCRIPTION OF PROPOSED RDT & E WORK: Install an Uninterrupted Power Supply, (UPS), system into BLDG 1440, the Ridely Mission Control Center, (MCC). The work shall include modification to the existing electrical system to accept the installation of the UPS system. Also include any other work required to make this a complete and useable system.

SPECIFIC PURPOSE: Provide capability to install and operate an UPS system.
PROJECT: Installation of an UPS system in the Ridely Mission Control Center.
REQUIREMENT: This project is required to support the installation of an UPS system to supply power to two critical circuits in the MCC when commercial power is lost. The existing computer systems and all the Mission Control rooms are the critical circuits that will be placed on this system. The rooms and computers support all AFFTC RDT & E aircraft flight test mission. This UPS system will also prevent the loss of critical and valuable data as a result from unschedule power outages.
CURRENT SITUATION: Presently the MCC operates without this type of backup system. This has resulted in the loss of critical test flight data due to unscheduled power outages.
IMPACT IF NOT PROVIDED: The MCC will continue to operate with the potential for the loss of valuable flight data. The loss of any critical flight data can result in the extension of test programs and cost overages.

(1153) 1125

1 COMPONENT AIR FORCE (AFSC)	FY 1988 RDT & E FACILITIES PROJECT DATA	2 DATE 12 DEC 86

3 INSTALLATION AND LOCATION	4 PROJECT TITLE
EDWARDS AIR FORCE BASE, CALIFORNIA	EQUIPMENT INSTALLATION: UPS FOR MISSION CONTROL CENTER

5 PROGRAM ELEMENT	6 CATEGORY CODE	7. PROJECT NUMBER	8 PROJECT COST ($000)
65807	317-315	880519 (80-22)	150.0

9 COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
EQUIPMENT INSTALLATION				
UPS FOR RIDELY MISSION CONTROL CENTER				150
ELECTRICAL MODIFICATIONS	LS			(150)
COST OF PURCHASED EQUIPMENT (NON-ADD)				(450)
TOTAL EQUIPMENT & INSTALLATION COST				600
OTHER NON-ADD COST				
DESIGN (10%)				(15)

10 DESCRIPTION OF PROPOSED RDT & E WORK: Install an Uninterrupted Power Supply, (UPS), system into BLDG 1440, the Ridely Mission Control Center, (MCC). The work shall include modification to the existing electrical system to accept the installation of the UPS system. Also include any other work required to make this a complete and useable system.

SPECIFIC PURPOSE: Provide capability to install and operate an UPS system.
PROJECT: Installation of an UPS system in the Ridely Mission Control Center.
REQUIREMENT: This project is required to support the installation of an UPS system to supply power to two critical circuits in the MCC when commercial power is lost. The existing computer systems and all the Mission Control rooms are the critical circuits that will be placed on this system. The rooms and computers support all AFFTC RDT & E aircraft flight test mission. This UPS system will also prevent the loss of critical and valuable test data as a result from an unscheduled power outage.
CURRENT SITUATION: Presently the MCC operates without this type of backup system. This has resulted in the loss of critical test flight data due to unscheduled power outages.
IMPACT IF NOT PROVIDED: The MCC will continue to operate with the potential for the loss of valuable flight data. The loss of any critical flight data can result in the extension of test programs and cost overages.

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1 COMPONENT	FY 1988 RDT&E FACILITIES PROJECT DATA	2 DATE
AIR FORCE		16 DEC 86

3 INSTALLATION AND LOCATION	4 PROJECT TITLE
EDWARDS AIR FORCE BASE, CALIFORNIA	EQUIPMENT INSTALLATION: A/C & POWER FOR AIRCRAFT

5 PROGRAM ELEMENT	6 CATEGORY CODE	7 PROJECT NUMBER	8 PROJECT COST ($000)
64226F	211-111	(80-22) 870521	1,980 INSTALLATION 198 DESIGN

9 COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
EQUIPMENT INSTALLATION: AIR CONDITIONING & ELECTION POWER FOR AIRCRAFT	LS			1,800
REFRIGERATED AIRCRAFT COOLING SYSTEMS	EA	2	192.5	(385)
HANGAR AIRCOOLING (EVAPORATIVE)	LS			(440)
ELECTRIC POWER ISLANDS	EA	2	150	(300)
SECONDARY ELECTRIC TRANSFORMERS	KVA	5000	135	(675)
SUBTOTAL				1,800
CONTINGENCY (10%)				180
TOTAL				1,980
DESIGN COST (NON-ADD)				198

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10. DESCRIPTION OF PROPOSED INSTALLATION Install two refrigerated air conditioning systems and two multi receptical power islands for aircraft testing within secure closed hangar.

PROJECT: Provides for modifications to existing hangar to accommodate two major test programs within a closed and security classified area.

REQUIREMENT: AFFTC has test program requirements to simulate and test aircraft systems under full electric power with cooling for aircraft within a phsically closed hangar area. This work must be accomplished by Dec 1988.

CURRENT SITUATION: Considering the current and projected work load at AFFTC, no other hangar facilities are available for these Combined Test Forces (CTF's). The hangar was primarily an aircraft maintenance facility. Therefore, it does not have the required special aircraft air conditioning nor the large electrical power islands with 27 recepticals each.

IMPACT IF NOT PROVIDED: Failure to accomplish this project will result in costly and scheduled delays in the testing, which these programs are required to do. Any delays are totally unacceptable for these programs with a Presidential priority of Brickbat 1-1.

1 COMPONENT (AFSC) AIR FORCE	FY 1988-90 RDT&E FACILITIES PROJECT DATA	2 DATE 14 Oct 86

3 INSTALLATION AND LOCATION	4 PROJECT TITLE
VANDENBERG AFB, CA (SAC)	TEST FACILITY SPACE TRANSPORTATION SYSTEM

5 PROGRAM ELEMENT	6 CATEGORY CODE	7 PROJECT NUMBER	8 PROJECT COST ($000)
35171 F	312-477		16,000

9 COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
Test Facility Space Transportation System (STS)	LS			16,000
Cost of Purchased Equipment (Non-Add)				(TBD)

10 DESCRIPTION OF PROPOSED RDT&E WORK: Continued alteration to various STS facilities to accommodate the installation of equipment that will be used in direct support of the STS mission. Includes various elements of construction and all work necessary to provide a complete and useable facility.

PROJECT: Construction and modifications to facilities for STS operations at Vandenberg AFB.

REQUIREMENT: Adequate facilities are required to support STS launch operations in a safe and reliable manner. Additions and modifications to launch facilities are necessary to keep current with systems improvements, flight vehicle characteristics, and payload processing operations as a part of joint NASA-DOD efforts to achieve space goals. The launch and support facilities which have been constructed need to be upgraded to meet changes in STS program directives, requirements, flight vehicle elements, support equipment hardware configurations, and procedures.

CURRENT SITUATION: Generally, facilities required for STS launches have been constructed. Systems requirements have been revised. Current test and operational readiness reviews indicate that modifications will be required to accommodate new support equipment systems.

IMPACT IF NOT PROVIDED: STS flight vehicle processing and launch operations may be jeopardized. Launch operations cannot be conducted in a safe and reliable manner.

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1 COMPONENT		2 DATE
(AFSC) AIR FORCE	FY 19 89 RDT&E FACILITIES PROJECT DATA	1 OCT 1986

3 INSTALLATION AND LOCATION	4 PROJECT TITLE
WRIGHT-PATTERSON AIR FORCE BASE, OHIO	EQUIPMENT INSTALLATION, INSTALL RECONFIGURABLE EC SIMULATOR, BLDG620

5 PROGRAM ELEMENT	6 CATEGORY CODE	7 PROJECT NUMBER	8 PROJECT COST ($000)
64738F	317-311	EQ 88-9100	1,500.0

9 COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
EQUIPMENT INSTALLATION, INSTALL RECONFIGURABLE ELECTRONIC COMBAT SIMULATOR				1,500.0
RAISED FLOORING	LS			(200.0)
SECONDARY UTILITIES	LS			(800.0)
AIR CONDITIONING	LS			(300.0)
MODULAR WALL & CEILING REMOVALS/MODS	LS			(200.0)
COST OF PURCHASED EQUIPMENT (NON-ADD)				(6,260.0)
TOTAL EQUIP AND INSTALLATION COST (NON-ADD)				(7,760.0)
OTHER NON-ADD COSTS (DESIGN)				(50.0)

10 DESCRIPTION OF PROPOSED INSTALLATION: Provide a secure TEMPEST facility to include installation of raised flooring, secondary utilities and air coditioning. Remove/modify modular walls and ceilings.

PROJECT: Provide a TEMPEST approved secret level automated data processing facility to support the Reconfigurable Electronic Combat Simulator (RECS).

REQUIREMENT: An adequate and properly configured secure TEMPEST facility is required to house RECS. This prototype and development facility is an integral part of the AFSC directed Electronic Combat Hierarchy of Simulations (ECHOS) program to insure that electronic combat evaluation capability is available for future Air Force development and acquisition programs. The RECS development must be carried out in a facility where the latest technical intelligence and order of battle data is available and usuable with state of the art electronic data processing resources.

CURRENT SITUATION: An adequate secure TEMPEST area is not presently available at the Avionics Laboratory for the computer and analysis work required to support RECS. As a result, the development of data bases and models is widely dispersed and there are numerous incompatibilities between existing data bases and models.

IMPACT IF NOT PROVIDED: Without this project, RECS cannot be implemented and the capability to support future decision making and improve the acquisition of weapon systems for the Air Force will be seriously jeopardized.

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1 COMPONENT	RDT&E FACILITIES FY 19 88 PROJECT DATA	2 DATE
Air Force		9 Oct 86

3 INSTALLATION AND LOCATION	4 PROJECT TITLE Equipment Installation
Wright-Patterson AFB OH	Install Turbine Research Laboratory, Bldg 18C

5 PROGRAM ELEMENT	6 CATEGORY CODE	7 PROJECT NUMBER	8 PROJECT COST ($000)
62203F	318-612		300.0

9 COST ESTIMATES

ITEM Equipment Installation	U/M	QUANTITY	UNIT COST	COST ($000)
Install Turbine Research Laboratory				300.0
Install Mechanical Equipment				(200.0)
Install Electrical Equipment and controls				(100.0)
Engineering Analysis Design and Documentation (Non-Add)				(223.0)
RDT&E Equipment (Non-Add)				(1190.0)

10 DESCRIPTION OF PROPOSED ~~CONSTRUCTION~~ RDT&E Work

All work necessary to install argon/freon supply tank, valves, combustor simulator and turbine research sections, turbine brake, heating/cooling system, dump tank, controls and instrumentation for the Turbine Research Laboratory in Bldg 18C, Rm 19.

PROJECT: Install the equipment indicated above, piping and secondary utilities to provide a fully functional Turbine Research Laboratory.

REQUIREMENT: This project will allow basic and exploratory research in turbine engine flow variable and heat transfer phenomenon. A means is required to quantitatively analyze heat transfer and viscous losses non-intrusively in actual turbine engine sections and models. This facility will provide the means to fully define heat transfer mechanisms, and aid in improving design techniques, validation of turbine design code, increase performance and the state-of-the-art of aircraft engines.

CURRENT SITUATION: At present, no facility exists to perform research on turbine heat transfer phenomenon and flow measurement capability in a non-intrusive environment.

IMPACT IF NOT PROVIDED: The most promising arena for the improvement of performance of a turbine engine is the "hot" section of the engine. Measurements in a full scale engine are prohibitively expensive and of questionable accuracy due to intrusive measurement techniques. Without this facility, the analytical tools to achieve improved performance will be unavailable to transition to turbine engine design and production centers.

1 COMPONENT (AFSC) AIR FORCE	FY 1988 RDT&E FACILITIES PROJECT DATA		2 DATE 14 OCT 1986
3 INSTALLATION AND LOCATION WRIGHT-PATTERSON AFB, OHIO (AFLC)		4 PROJECT TITLE EQUIPMENT INSTALLATION OF CRAY X-MP/48 COMPUTER SYSTEM, BLDG 676	
5 PROGRAM ELEMENT 62201F, 62202F, 62203F & 62204F	6 CATEGORY CODE 610-711	7 PROJECT NUMBER EQ 88-9102	8 PROJECT COST ($000) (EEIC 592) 400.0

9 COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
EQUIPMENT INSTALLATION OF CRAY X-MP/48 COMPUTER SYSTEM, BLDG 676	LS			400.0
COST OF COMPUTER EQUIPMENT (NON-ADO)	LS			(21,825.0)
TOTAL EQUIPMENT AND INSTALLATION COST (NON-ADO)				(22,225.0)
OTHER NON-ADO COSTS: DESIGN COSTS	LS			(30.0)

10 DESCRIPTION OF PROPOSED RDT&E work: Consists of site preparation to support the installation of a Cray X-MP/48 Computer System, with a Solid State Storage Device. Site preparations include the installation of a motor generator, power distribution units and associated power wiring; installation of two refrigeration condensing units with water/freon piping and reinforcement of sub-floor to sustain the equipment loading requirements.

PROJECT: Installation of a Cray X-MP/48 Computer System in Bldg 676 to upgrade local supercomputer processing capability to support the ASD-AFWAL R&D mission.

REQUIREMENT: A FY85 study conducted by the ASD Technical Evaluation Team specified a two-phase system to provide for a growth in supercomputer processing capability as ASD's spectrum of computer analyses enlarges. The current growth rate projection indicates the second phase system must be a Cray X-MP/48 to keep abreast of the processing requirements of the ASD-AFWAL R&D community.

CURRENT SITUATION: Currently, a Cray X-MP/12 Computer System provides supercomputer processing capability to support the ASD-AFWAL mission. However, analysis techniques have developed that will not be amenable to this system because of large central memory and/or auxiliary memory requirements. Therefore, to provide the ASD-AFWAL community with state-of-the-art computer capability to support their R&D mission, a Cray X-MP/48 computer with a solid state storage device is being installed.

IMPACT IF NOT PROVIDED: Some ASD-AFWAL projects will accrue excessive costs due to the use of commercial service centers. Other projects will experience delays due to the limited analysis techniques available on the existing system. Some mission support projects will not be undertaken due to projected costs and time limitations.

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1 COMPONENT	FY 19 87 RDT&E FACILITIES PROJECT DATA			2 DATE
AIR FORCE				OCT 86

3 INSTALLATION AND LOCATION	4 PROJECT TITLE
(UTTR/WENDOVER AREA, UTAH) EGLIN AIR FORCE BASE, FLORIDA	TEST FACILITY - CONST STEEL ARCH IGLOOS PHASE I

5 PROGRAM ELEMENT	6 CATEGORY CODE	7 PROJECT NUMBER	8 PROJECT COST ($000)
63601F	141-181	EGL 87-0093	$ 1,200.0

9 COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
Test Facility - Const Steel Arch Igloos	LS			1,200.0
Igloo	EA	8	60,000	(480.0)
Site Preparation, Access Road	LS			(720.0)
Total Cost				1,200.0

10. DESCRIPTION OF PROPOSED RDT&E WORK:
Construct access road and 8 earth mounded, steel-arch munitions storage igloos. Each igloo to have a 28'x40' concrete floor, 13' radius corrugated steel arch roof, concrete back and front (w/steel door) end walls. Temporary access roads adequate to handle construction equipment and movement of large quantities of bombs (MK-82).
PROJECT: Provides for test facilities to support the HAVE BLOCK program.
REQUIREMENT: The Air Force has requirements to transport, store, and load munitions on aircraft while in close proximity to other munitions. Due to the danger that the inadvertent detonation of one munition could result in the sympathetic detonation of other munitions, safety restrictions have been imposed to reduce the hazard to personnel and property. These restrictions apply to the quantity of munitions (usually expressed as Net Explosive Weight (NEW)) that may be stored in a particular area and the distance that they must be located from other munitions and facilities. The restrictions are most stringent when associated with mass detonating munitions. Because of the danger associated with mass detonating munitions, very limited quantities of these munitions (i.e., MK-80 series bombs) may be stored in one place without imposing large Q-D requirements. Specifically, while normal explosives storage structures are designed to hold 250,000 to 500,000 pounds NEW, USAFE currently averages only 60,000 to 80,000 NEW of mass detonating munitions per structure due to the Q-D restrictions. This limits the number of munitions stored at forward bases and restricts the Air Force's ability to sustain wartime operations. A mechanical deterrent to sympathetic detonation (MDSD) could substantially

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1. COMPONENT	FY 1987 RDT&E FACILITIES PROJECT DATA	2. DATE
AIR FORCE		OCT 86

3. INSTALLATION AND LOCATION
(UTTR/WENDOVER AREA, UTAH)
EGLIN AIR FORCE BASE, FLORIDA

4. PROJECT TITLE	5. PROJECT NUMBER
TEST FACILITY - CONST STEEL ARCH IGLOOS PHASE I	EGL 870093

REQUIREMENT (Continued): alleviate this problem with mass detonating munitions. The Mechanical Deterrents to Sympathetic Detonation program (HAVE BLOCK) will provide a means for implementing deterrent techniques in "real world" conditions and demonstrate their viability to the logistic, safety, and operational communities through a series of critical tests. Due to their large numbers and usage, general purpose bombs will receive the initial emphasis. The desired output of this program is technical data which can be used for procuring the devices or equipment and implemented in technical orders, and operating instructions and procedures for MDSD devices for the MK-82 and MK-84. The operational environment addressed will be bombs in igloo storage and within hardened aircraft shelters. This program addresses AFLC Statement of Operational Need (SON) 02-83 "Munitions Hazard Reduction Program" and PMD 3035(32)/63601F direction (interim Form 56, 121600Z Mar 86). The test igloo will be loaded with large quantities of bombs (240 to 390 MK-82s) that will be separated by MDSD devices. A single donor bomb will be exploded to determine how well the devices prevent explosive propagation to the other bombs.

CURRENT SITUATION: Igloos that can be consumed by testing do not currently exist. Most are located in storage areas where explosions cannot be tolerated.

IMPACT IF NOT PROVIDED: This most critical phase of the HAVE BLOCK DT&E could not be done. Open air testing with lesser quantities of bombs will be conducted during DT&E. Proof of how well the device suppress detonation within a confinement must be done in a structure representative of the "real world".

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1. COMPONENT	FY 19 88 RDT&E FACILITIES PROJECT DATA	2. DATE
AIR FORCE		OCT 86

3. INSTALLATION AND LOCATION	4. PROJECT TITLE
(UTTR/WENDOVER AREA, UTAH) EGLIN AIR FORCE BASE, FLORIDA	TEST FACILITY - CONST STEEL ARCH IGLOOS PHASE II

5. PROGRAM ELEMENT	6. CATEGORY CODE	7. PROJECT NUMBER	8. PROJECT COST ($000)
63601F	141-181	EGL 88-0021	$ 560.0

9. COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
Test Facility - Const Steel Arch Igloos	LS			560.0
Igloo	EA	8	60,000	(480.0)
Site Preparation, Remove Rubble	LS			(80.0)
Total Cost				560.0

10. DESCRIPTION OF PROPOSED RDT&E WORK:
Remove rubble from igloos damaged by testing live bombs in Phase I and construct 8 earth mounded, steel-arch storage igloos. Included will be removal of concrete and steel from test-damaged igloos, restoration of the subgrade and identical activities as Phase I to build 8 igloos. MK-84 bombs will be used in this phase.
PROJECT: Provides for test facilities to support the HAVE BLOCK program.
REQUIREMENT: The Air Force has requirements to transport, store, and load munitions on aircraft while in close proximity to other munitions. Due to the danger that the inadvertent detonation of one munition could result in the sympathetic detonation of other munitions, safety restrictions have been imposed to reduce the hazard to personnel and property. These restrictions apply to the quantity of munitions (usually expressed as Net Explosive Weight (NEW)) that may be stored in a particular area and the distance that they must be located from other munitions and facilities. The restrictions are most stringent when associated with mass detonating munitions. Because of the danger associated with mass detonating munitions, very limited quantities of these munitions (i.e., MK-80 series bombs) may be stored in one place without imposing large Q-D requirements. Specifically, while normal explosives storage structures are designed to hold 250,000 to 500,000 pounds NEW, USAFE currently averages only 60,000 to 80,000 NEW of mass detonating munitions per structure due to the Q-D restrictions. This limits the number of munitions stored at forward bases and restricts the Air Force's ability to sustain wartime operations. A

1. COMPONENT	FY 1988 RDT&E FACILITIES PROJECT DATA	2. DATE
AIR FORCE		OCT 86

3. INSTALLATION AND LOCATION
(UTTR/WENDOVER AREA, UTAH)
EGLIN AIR FORCE BASE, FLORIDA

4. PROJECT TITLE	5. PROJECT NUMBER
TEST FACILITY - CONST STEEL ARCH IGLOOS PHASE II	EGL 880021

REQUIREMENT (Continued): alleviate this problem with mass detonating munitions. The Mechanical Deterrents to Sympathetic Detonation program (HAVE BLOCK) will provide a means for implementing deterrent techniques in "real world" conditions and demonstrate their viability to the logistic, safety, and operational communities through a series of critical tests. Due to their large numbers and usage, general purpose bombs will receive the initial emphasis. The desired output of this program is technical data which can be used for procuring the devices or equipment and implemented in technical orders, and operating instructions and procedures for MDSD devices for the MK-82 and MK-84. The operational environment addressed will be bombs in igloo storage and within hardened aircraft shelters. This program addresses AFLC Statement of Operational Need (SON) 02-83 "Munitions Hazard Reduction Program" and PMD 3035(32)/63601F direction (interim Form 56, 121600Z Mar 86). The test igloo will be loaded with large quantities of bombs (240 to 390 MK-82s) that will be separated by MDSD devices. A single donor bomb will be exploded to determine how well the devices prevent explosive propagation to the other bombs.

CURRENT SITUATION: Igloos that can be consumed by testing do not currently exist. Most are located in storage areas where explosions cannot be tolerated.

IMPACT IF NOT PROVIDED: This most critical phase of the HAVE BLOCK DT&E could not be done. Open air testing with lesser quantities of bombs will be conducted during DT&E. Proof of how well the device suppress detonation within a confinement must be done in a structure representative of the "real world".

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U.S.G.P.O. 1984-423-979/13471

1 COMPONENT	FY 1987 RDT&E FACILITIES PROJECT DATA	2 DATE
AIR FORCE		30 Sep 86

3 INSTALLATION AND LOCATION	4 PROJECT TITLE
UTAH TEST AND TRAINING RANGE, UTAH	Retrofit/Redesigned Aircraft Shelter Test Article

5 PROGRAM ELEMENT	6 CATEGORY CODE	7 PROJECT NUMBER	8 PROJECT COST ($000)
64617F	141-182		$4200.0

9 COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
Electrical/Mechanical Equipment Installation	LS			$ 600.0
Structural Retrofits	LS			600.0
Redesigned Aircraft Shelter Test Article . .	LS			3000.0
Total Funded Cost.				$4200.0
Total Unfunded Cost (Design)				250.0
Total Project Cost				$4450.0

10 DESCRIPTION OF PROPOSED RDT&E WORK

Install electrical/mechanical operating equipment and various retrofits to the existing third generation aircraft shelter test article to determine equipment response to conventional weapons and validate retrofit designs to upgrade the survivability of existing semihardened aircraft shelters. Construct a full-scale aircraft shelter test article to study and validate new designs against a balanced conventional weapon threat criteria.

11.

PROJECT: Procure and install appropriate electrical/mechanical equipment in the existing third generation aircraft shelter test article. Construct various retrofits to the floor and arch as determined necessary to the existing shelter. Prepare the test site and construct a full-scale aircraft shelter test article incorporating the new designs as determined from this program.

REQUIREMENT: The equipment installed in operational aircraft shelters must be evaluated for its equipment response and vulnerabilities to conventional weapons effects. This is necessary to determine the overall vulnerability of an existing aircraft shelter to the existing threat criteria. Additionally, retrofit designs to the shelters' floor and arch have not been validated to the existing threat criteria. This must be accomplished to provide a method of increasing the survivability of existing semihardened aircraft shelters. The current designs of the various shelter components (i.e. front and rear doors/wall, arch, floor and foundation) must be reevaluated and modified to survive against a balanced design

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1 COMPONENT AIR FORCE	FY 1987 RDT&E FACILITIES PROJECT DATA	2 DATE 30 Sep 86
3 INSTALLATION AND LOCATION UTAH TEST AND TRAINING RANGE, UTAH		
4. PROJECT TITLE RETROFIT/REDESIGNED AIRCRAFT SHELTER TEST ARTICLE		5. PROJECT NUMBER

11. (Continued)
criteria rather than the existing criteria which is not as critical for the front and rear doors/wall as for the arch. A full scale aircraft shelter must then be constructed incorporating all the new designs to study and validate them against a balanced conventional weapon threat criteria. This must be accomplished so the new designs can be confidently incorporated in the construction of the approximately 700 new shelters programmed for the next five years, thus correcting the identified vulnerabilities/deficiencies of the existing shelters.

CURRENT SITUATION: The existing shelters currently in operational use were designed for the NATO conventional threat of 1971. Additionally, the current designs are based on the technologies of the late 1960's and early 1970's. Thus, the degree of survivability versus cost ratio is not as great nor as efficient as it could be by using current design/construction technologies. The various shelter types and components within a particular shelter provide differing levels of protection which does not meet the most realistic threat of a balanced threat criteria. Also, the actual protection provided by the current designs, particularly for the installed equipment, is not fully understood.

IMPACT IF NOT PROVIDED: Field test validation of various retrofit designs and new shelter designs will not be performed. The response and vulnerabilities of the installed equipment to conventional weapons effects will not be evaluated nor understood for possible correction to meet existing threats. As such, the existing shelters survivability will not be increased confidently of efficiently. Also, all new shelters being constructed will remain as vulnerable as those currently in the inventory which should not be operationally acceptable.

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DD FORM 1 DEC 76 1391c PREVIOUS EDITION IS OBSOLETE IN THE USAF. PAGE NO

1 COMPONENT AIR FORCE	FY 19 87 RDT&E FACILITIES PROJECT DATA	2 DATE OCT 86

3 INSTALLATION AND LOCATION	4. PROJECT TITLE
EGLIN AIR FORCE BASE, FLORIDA	TEST FACILITY - RECONSTRUCT CONCRETE TARGET

5 PROGRAM ELEMENT	6 CATEGORY CODE	7 PROJECT NUMBER	8 PROJECT COST ($000)
64612F 28030F/64602F	.111-111	EGL 87-0092	$ 463.0

9 COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
Test Facility - Reconstruct Concrete Target	LS			463.0
Rubble Removal	CY	6,000	14.00	(84.0)
Repair Subgrade	CY	3,000	7.00	(21.0)
Replace 12" thick PCC Pavement	SY	5,800	35.00	(203.0)
Replace 24" thick PCC Pavement	SY	2,100	57.00	(120.0)
Seal Joints	LF	20,000	1.00	(20.0)
Repair Shoulders & Drainage	LS			(15.0)
Total Cost				463.0

10. PROPOSED DESCRIPTION OF RDT&E WORK:
Reconstruct the concrete hard impact bed to include removal of damaged concrete, restore sand and clay subgrade, replacing 12" and 24" thick concrete, seal joints, reshaping earth shoulders and replacement of drainage structures.

PROJECT: Provides for restoring a multi-use concrete impact target for future tests. This pad is 400' by 800' and consists of unreinforced concrete 1' thick except for the center circular area that is 200' in diameter and 2' thick.

REQUIREMENT: AD continues to be heavily involved in the development and procurement of explosives, warheads and fuzes designed for attacking concrete structures. This dictates that large concrete targets be available to support test objectives that call for evaluation of the munitions capabilities to survive hard impacts, function properly and produce damage. Historically, specific programs do not project target needs far enough in advance to allow normal budget, procurement and construction cycles.

CURRENT SITUATION: This target contains damage from extensive testing over the past two years; damage is from I-2000 Pound Bomb, BLU-109 and Durandal tests. Schedule did not permit repair during that period.

IMPACT IF NOT PROVIDED: All testing programs needing large area horizontal concrete targets will be subjected to the risk of impacting expensive test hardware on present damage or be placed in direct competition for a target that has been expanded by funds from a program (DAACM/BKEP) that expects exclusive use.

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1. COMPONENT	FY 1989 RDT & E FACILITIES PROJECT DATA	2. DATE
AIR FORCE (AFSC)		12 DEC 86

3. INSTALLATION AND LOCATION	4. PROJECT TITLE
EDWARDS AIR FORCE BASE, CALIFORNIA	TEMPORARY CONSTRUCTION: C-17A AIRDROP TEST COMPLEX

5. PROGRAM ELEMENT	6. CATEGORY CODE	7. PROJECT NUMBER	8. PROJECT COST ($000)
64231F	319-443	FSPM 880007 (80-22)	4,730

9. COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
C-17A AIRDROP TEST COMPLEX	LS			4,300
C-17A AIR DROP FACILITIES	LS			3,895
LOAD BUILDUP/RIGGING AREA	SF	16,000	115.00	(1,840)
PARACHUTE SHAKE-OUT TOWER	SF	3,000	460.00	(1,380)
MOD 1411 FOR PARA PACKING/FAB AREA	SF	17,278	39.00	(675)
SUPPORTING FACILITIES	LS			405
ELECTRIC, COMMUNICATION	LF	750	46.00	(35)
TRANSFORMERS	KVA	300	52.00	(16)
WATER, SEWER, HEAT	LS			(100)
ROADS, PARKING, & STORAGE YARD	LS			(200)
FENCING	LF	800	21.50	(17)
SITE PREPARATION	SY	6,800	5.50	(37)
TOTAL				4,300
DESIGN COST				(430)
GRAND TOTAL				4,730

10. DESCRIPTION OF PROPOSED RDT & E WORK: Construct a C-17A Airdrop Test Complex comprising of 19,000 SF. The complex consist of three major sections; Load Buildup/Rigging (16,000 SF), Parachute Shake-out tower (3,000 SF), and modify Bldg 1411 for Parachute Packing/Fabrication requirements (17,278.AF). Provide access roads, fenced storage yards, parking, all utilities and meters.

PROJECT: Construct new 19,000 SF C-17A Airdrop Test Complex to house airdrop build-up, shake-out drying tower, storage, shop office, latrine facilities, provide secure storage yard and parking and modify building 1411 for packing and fabrication area (17,278 SF).

REQUIREMENT: The C-17A Transport System Test program involves the testing of a number of large and heavy cargo load drops over the duration of the program. The size of this program and the associated loads require a facility dedicated to C-17A load buildup and handling. The C-17A program requires airdropping up to 200 different heavy platform loads, 60% of which will weigh over 20,000 lbs each and 20% over 35,000 lbs, with unit platform loads weighing as much as 60,000 lbs. More than 450 A-22 containers weighing 2,000 lbs each will be airdropped. More than 1100 cargo parachutes from 64 to 137 ft diameter and more than 400 extraction parachutes and 1300 other small chutes up to 35 ft diameter are required. More than 2100 personnel type parachutes will be used. Platforms and A-22 containers aggregate weight to be airdropped during this program exceeds 6 million pounds. Loads up to 32 ft long X 9 ft wide will be rigged at the rate of as many as 10-12 large platforms and 70 each 100 ft or 137 ft diameter parachutes in a single week. This is the reason for the exten-

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1. COMPONENT AIR FORCE (AFSC)	FY 1989 RDT & E FACILITIES PROJECT DATA	2. DATE 1 OCT 86

3. INSTALLATION AND LOCATION

EDWARDS AIR FORCE BASE, CALIFORNIA

4. PROJECT TITLE	5. PROJECT NUMBER
C-17A AIRDROP TEST COMPLEX	(80-22) FSPM 880007

sive production line facilities set up for the C-17A program. We plan on four 32 ft platforms being rigged at a time. Six to ten 100 ft or 137 ft diameter packed parachutes will be placed on each fully rigged load at the end of the line, after which the loads will be lifted by overhead crane onto a K-loader and carried to the aircraft for onloading. Required Beneficial Occupancy Date (BOD) is Dec 89 for the entire complex.

CURRENT SITUATION: Edwards AFB does not presently have facilities to support the C-17A Airdrop Test Program. The present load buildup, packing and fabrication facilities will not handle the oversized cargo loads and parachutes. Large loads must be built in the Weight and Balance Facility. When weight and balance activities are scheduled, load buildup must be stopped. This facility cannot be used to meet the load buildup requirements of the C-17A program. A shake-out/drying tower for airdrop test programs does not exist. Inadequate facilities such as the Missile Assembly Building at the Air Force Rocket Propulsion Lab complex and the Weight and Balance Facility are being used for parachute shake-out and drying. Parachutes are transported 30 miles to the Missile Assembly Building for partial shake-out while suspended from a single overhead crane hook which, at 50 ft above the building floor, is too low for suspension of the larger parachute canopies. Parachutes left suspended for shake-out are subject to contamination from dust and bird excrement. The use of the Weight and Balance Facility to shake-out parachutes presents a problem due to the ongoind operational requirements of this building. In addition to the weight and balance function, this facility is used for aircraft moments of inertia and vibration testing. The crane used to raise the parachutes is located near the aircraft weighing scales and moments of inertia table. Each time a 100 ft canopy is shaken, approximately one cu ft of dust and debris falls out. This debris could damage the gear mechanisms and control surfaces of the scales in the floor, affecting their accuracy. This could potentially cause an aircraft accident or incident, endangering lives and property. This facility will not handle shake-out of the newer, larger parachutes and with only one crane, cannot approach handling the volume requirements of the C-17A program.

IMPACT IF NOT PROVIDED: The C-17A Airdrop Program cannot be accomplished in a timely manner at AFFTC without completion of this project by Dec 89. The current facilities will not handle the physical size and weight of the build-up loads and parachutes. No other Government facilities exist which are adequate to support the requirement. The added cost to the flight test program, caused by delays in the load build-up process, will far exceed the cost of this facility. AFFTC is the AFSC Center of Expertise for parachute and cargo aerial delivery systems. Current facilities are manpower intensive and totally inadequate for the task.

DD FORM 1 DEC 76 1391c PREVIOUS EDITION IS OBSOLETE IN THE USAF.

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1 COMPONENT AIR FORCE (AFSC)	FY 19_87 RDT & E FACILITIES PROJECT DATA	2 DATE 5 SEP 85

3 INSTALLATION AND LOCATION	4 PROJECT TITLE
EDWARDS AIR FORCE BASE, CALIFORNIA	TEMPORARY CONSTRUCTION SKI JUMP RAMP

5 PROGRAM ELEMENT	6 CATEGORY CODE	7 PROJECT NUMBER	8 PROJECT COST ($000)
63307F	111-111	870504 (80-22)	150.0

9 COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
TEMPORARY CONSTRUCTION				
SKI JUMP RAMP				109.1
FILL	CY	2,500	29.00	(72.5)
BASE	CY	225	39.00	(8.8)
CONCRETE PAVEMENT	CY	335	83.00	(27.8)
SUBTOTAL				109.1
CONTINGNCIES (10%)				10.9
TOTAL CONSTRUCTION COST				120.0
OVERHEAD & PROFIT (25%)				30.0
TOTAL FUNDED COST				150.0
UNFUNDED COST (DESIGN, 10%)				15.0
TOTAL COST				165.0

10 DESCRIPTION OF PROPOSED ~~CONSTRUCTION~~

RDT&E Work: Concrete covered earthen mound on Rogers Dry Lakebed adjoining taxiway "D". Ramp will be 180' long and 14' high at the exit. The ramp will be demolished upon completion of the test program.

PROJECT: Construction of a ramp to support the SKI JUMP program.

REQUIREMENT: To validate the concept of Air Force aircraft using a SKI JUMP ramp as a means of both shortening the aircraft's takeoff roll and providing a means for an alternate launch surface should the main runway be inoperative.

CURRENT SITUATION: There is no existing facility in the DOD which can support this test program. A similar facility at the Naval Air Test Center cannot be used due to the excessive gear loads it would impart on Air Force aircraft even if the ramp were modified.

IMPACT IF NOT PROVIDED: Without this project the AFFTC cannot support the SKI JUMP program and the validity of the SKI JUMP concept cannot be adequately evaluated.

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1 COMPONENT	FY1987 RDT&E FACILITIES PROJECT DATA	2 DATE
AIR FORCE		9 JAN 1987

3 INSTALLATION AND LOCATION	4. PROJECT TITLE
MCCLELLAN AIR FORCE BASE, CALIFORNIA	PROTOTYPE--STATIONARY NEUTRON RADIOGRAPHY SYSTEM

5 PROGRAM ELEMENT	6 CATEGORY CODE	7 PROJECT NUMBER	8 PROJECT COST ($000)
7.80.26	211-153	PRJY879351	4,150

9 COST ESTIMATES

ITEM	U/M	QUANTITY	UNIT COST	COST ($000)
PROTOTYPE--STATIONARY NEUTRON RADIOGRAPHY SYSTEM	LS			3,747
REACTOR SHIELDING AND CONTAINMENT	LS			(1,455)
NEUTRON RADIOGRAPHY SYSTEM STRUCTURE	SF	10,400	160	(1,664)
SITE PREPARATION	LS			(300)
DESIGN	LS			(328)
SUBTOTAL				3,747
CONTINGENCY (5%)				187
TOTAL CONTRACT COST				3,934
SUPERVISION, INSPECTION AND OVERHEAD (5.5%)				216
TOTAL REQUEST				4,150
ACQUISITION COST FOR R & D EQUIPMENT (NON-ADD)				(6,400)
MINOR CONSTRUCTION PROJECT FUNDED FROM INDUSTRIAL FUNDS (DMS-AFIF) (NON-ADD)				(190)

10 DESCRIPTION OF PROPOSED RDT&E WORK: Install a fully equipped 250-kilowatt Training Research Isotope General Atomic (TRIGA) nuclear reactor system including parts handling, neutron beam, imaging, shielding, and safety systems. Containment structure constructed of reinforced concrete around reactor and exposure areas, with concrete block and prefabricated metal upper structure. Area includes water filled reactor tank, four radiography bays and control centers, preparation areas, and direct-support/equipment areas.

PROJECT: Construct a prototype Stationary Neutron Radiography System (SNRS) for non-destructive inspection (NDI) of aircraft components.

REQUIREMENT: A neutron radiography system and associated safety and operational equipment to perform NDI on components of F-111, F-4, and A-10 aircraft. The system will be used to detect low level hidden corrosion, detect water in honeycomb panels, examine adhesive bonded assemblies, inspect explosive devices, inspect critical bearings for condition of lubricants, and detect damage in composite structures. No such capability now exists within DOD. A prototype facility is needed to validate the utility and cost effectiveness of a stationary neutron reactor system for detecting hidden structural defects in aircraft components.

CURRENT SITUATION: X-ray and ultrasonic equipment are presently being used to inspect aircraft and other weapons system components. Those systems are incapable of detecting low levels of corrosion and moisture. Due to these current inspection systems, some damaged components appear to be serviceable and are returned to service without repair. To avoid the possibility of failure, many panels are completely rebuilt when minor

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1. COMPONENT AIR FORCE	FY1987 RDT&E FACILITIES PROJECT DATA	2. DATE 9 JAN 1987
3. INSTALLATION AND LOCATION MCCLELLAN AIR FORCE BASE, CALIFORNIA		
4. PROJECT TITLE PROTOTYPE--STATIONARY NEUTRON RADIOGRAPHY SYSTEM		5. PROJECT NUMBER PRJY879351

repairs would suffice. These problems, if detected in the earliest stages, can be corrected at minimal cost.

IMPACT IF NOT PROVIDED: Due to the inability to detect nearly invisible defects, some components will undergo costly rebuilding when minor or no repair is needed, thereby wasting money and keeping aircraft out of commission unnecessarily. Other components with undetectable defects may be re-used, causing further corrosion and continued deterioration, which could result in catastrophic failure and loss of aircraft and lives.